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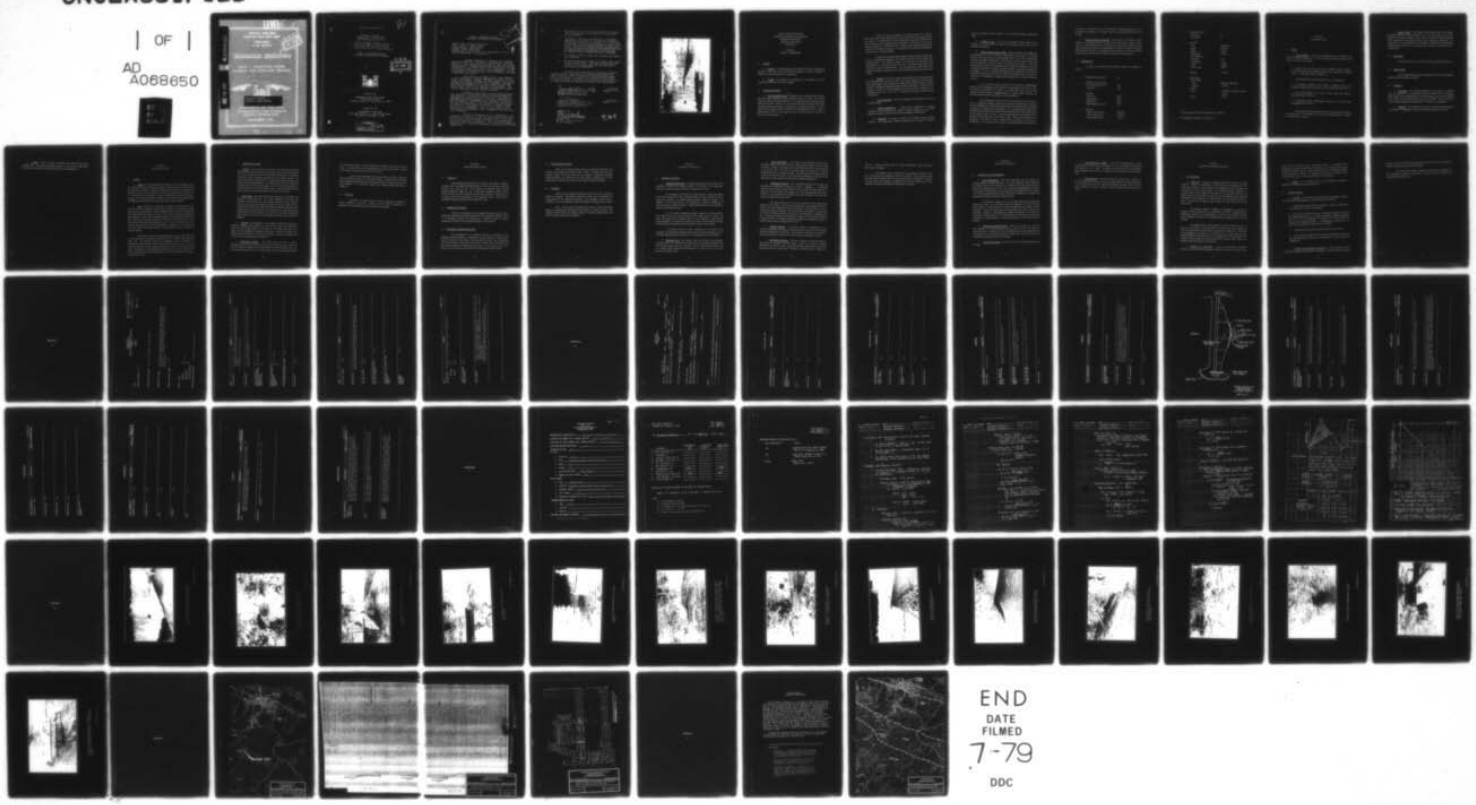

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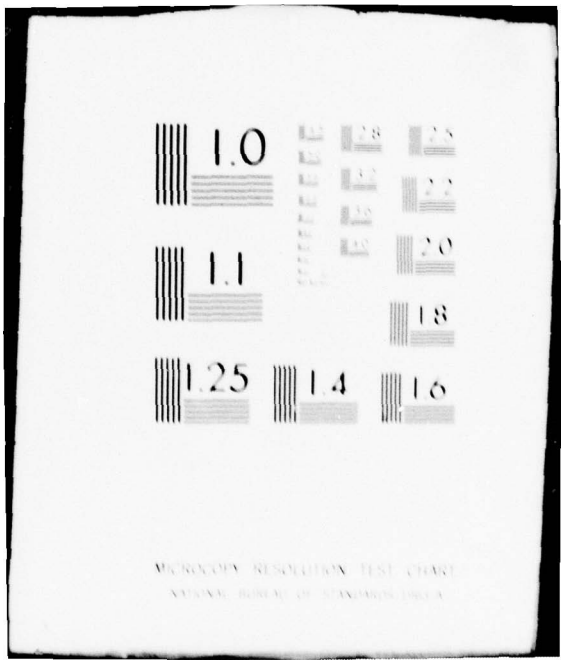
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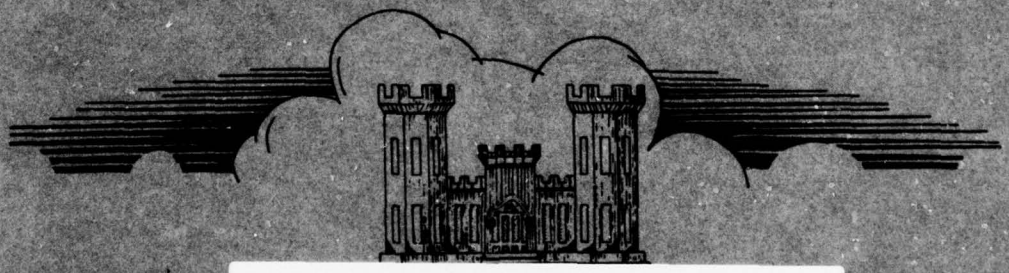
LEVEL II

SCHUYLKILL RIVER BASIN
INDIAN RUN CREEK, BERKS COUNTY
PENNSYLVANIA
ID NO. PA. 00713

BIRDSBORO RESERVOIR

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM



DEPARTMENT OF THE ARMY
Baltimore District, Corps of Engineers
Baltimore, Maryland 21203

SEPTEMBER 1978

147

SCHUYLKILL RIVER BASIN

BIRDSBORO RESERVOIR
BERKS COUNTY, PENNSYLVANIA
NATIONAL I.D. NO. PA 00713

(6) (Inspection)
National Dam Safety Program. Birdsboro Reservoir (PA-00713), Schuylkill River Basin, Indian Run Creek, Berks County, Pennsylvania. Phase I Inspection Report,

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

(12) 75p.

(10) John H./Frederick William S./Gardner

(15) DACW31-78-C-0048

Prepared by:

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Plymouth Meeting, Pennsylvania 19462

Submitted to:

DEPARTMENT OF THE ARMY
Baltimore District, Corps of Engineers
Baltimore, Maryland 21203

(11) September 1978

394 157

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

Name of Dam: Birdsboro Reservoir
County Located: Berks County
State Located: Pennsylvania
Stream: Indian Run Creek
Coordinates: Latitude 40° 14.4' Longitude 75° 49.2'
Date of Inspection: 29 August 1978

Birdsboro Reservoir is owned by the Birdsboro Municipal Authority in Birdsboro, Pennsylvania. The dam serves as a principal source of water for the town and surrounding areas. Limited records indicate that the dam was constructed in the 1880's but failed in 1892 due to a break in the water supply pipe buried in the embankment. It was reconstructed in that same year, and the reservoir has been in operation ever since.

The facility is judged to be in good condition in that there were no unusual embankment or crest distortions, misalignment, evidence of slope instability or other features to indicate that the dam is unstable. The spillway was also assessed to be in good condition with some minor erosion occurring at the end of the spillway. The intake tower could not be inspected but has been in operation for the past 64 years without incident.

Hydrologic and hydraulic calculations indicate that the end of the spillway wall would be overtopped at approximately 25 percent of the PMF, and the dam would be overtopped at about 61 percent of the PMF. Although the spillway would be overtopped first, the end of the spillway is founded on erosion resistant materials, and erosion incurred by overtopping is not expected to cause catastrophic failure. Overtopping of the dam is judged to cause failure of the embankment. Based on these calculations, the spillway is considered to be "Inadequate" but not "Seriously Inadequate".

The dam is classified as an "Intermediate" size structure by virtue of its 40 foot height and is also classified as a "High" hazard dam consistent with its potential for extensive property damage and loss of life downstream along Hay Creek and in Birdsboro. The following recommended remedial work is considered necessary and should be performed immediately.

1. The pond drain system should be checked to insure that the reservoir can be drained in the event of an emergency.

2. The water at the base of the dam is considered undesirable and should be checked by a registered professional engineer to determine if it is a natural marsh area or seepage through the dam or foundation. This can be accomplished by regrading the toe of the dam and evaluating the seepage locations. If underseepage is determined to be occurring, an inverted filter blanket should be installed.

3. The intake structure should be inspected for debris and integrity.

4. The water supply pipe should be fitted with a valve at the control tower. This will enable the flow to be cut off in the event the pipe develops a leak within the embankment.

The Owner should develop an inspection checklist together with an inspection and maintenance procedure to insure that all items are properly and periodically inspected and maintained. Because of the downstream population, a formal procedure of observation and warning during periods of high precipitation should be developed and implemented.

John H. Frederick, Jr., P.E. — 9/22/78
Date
Maryland Registration 7301
Woodward-Clyde Consultants

W S Gardner — 9/22/78
William S. Gardner, P.E. — Date
Pennsylvania Registration 4302E
Woodward-Clyde Consultants

APPROVED BY:

[illegible] WITHERS — 28 Sep 78
Date
Colonel, Corps of Engineers
District Engineer

OVERVIEW
BIRDSBORO RESERVOIR, BERKS COUNTY, PENNSYLVANIA

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM
BIRDSBORO RESERVOIR
NATIONAL ID #PA 00713
DER ID #6-6

SECTION 1
PROJECT INFORMATION

1.1 General.

a. Authority. The Dam Inspection Act, Public Law 92-367, authorized the Secretary of the Army, through the Corps of Engineers, to initiate a program of inspection of dams throughout the United States.

b. Purpose. The purpose of the inspection is to determine if the dam constitutes a hazard to human life or property.

1.2 Description of Project.

a. Dam and Appurtenances. Birdsboro Dam is an approximately 40-foot high rolled earth embankment constructed across Indian Run Creek. The 430-foot long dam impounds an 8-acre reservoir. Very limited data exists regarding physical features of the dam. However, it is known that local borrow material from within the reservoir area was used for the construction. The downstream slope is a 1.5H:1V slope, and the upstream slope is covered with hand-placed riprap on a slope of approximately 2.5H:1V. It is not known if there is a cutoff wall, nor is it known if a grout curtain was installed.

As shown on Plate 3, Appendix E, the intake structure is a masonry tower with a water intake approximately 6.5 feet high and 5.5 feet wide, protected by a grating. It is reported that a 12-inch water supply intake pipe is located at the base of the tower which supplies the town of Birdsboro. A branch in the 12-inch line serves as a pond drain. As noted on Plate 3, there is also an upstream intake orifice and valve at the base of the tower. It is reported by the Owner's representatives that this valve is no longer operable.

The spillway is located along the right abutment, and was reconstructed in 1916 to its present configuration. The spillway is 20 feet wide with 4-foot high retaining walls. The spillway channel is constructed of hand-placed rock approximately 12 inches square and 2 feet long. The oblong rocks were placed vertically to line the channel bottom. The retaining walls on both sides of the channel are masonry. The spillway is a simple channel containing no control section or weir.

b. Location. The dam is located across Indian Run Creek approximately 0.5 miles above the mouth of Hay Creek. Hay Creek discharges into the Schuylkill River approximately 2.5 miles below the confluence of Indian Run and Hay Creek. The dam is located near Birdsboro, Berks County, Pennsylvania. The dam site and reservoir are shown on USGS Quandrangle entitled, "Elverson, Pennsylvania", at coordinates N 40° 14.4' W 75° 49.2'. A regional location plan is enclosed as Plate 1, Appendix E.

c. Size Classification. The dam is classified as "Intermediate" by virtue of its 40-foot height.

d. Hazard Classification. A "High" hazard classification is assigned consistent with the potential for extensive property damage and loss of life downstream along Hay Creek and in the town of Birdsboro, Pennsylvania.

e. Ownership. The dam is owned by the Birdsboro Municipal Water Authority. All correspondence should be addressed to Mr. Nicholas J. DeSantis,

Chairman, Birdsboro Municipal Authority, 113 Main Street, Birdsboro, Pennsylvania 19508.

f. Purpose of Dam. The dam was designed to supply water to the foundries. In 1910, the reservoir became the water supply source for the town of Birdsboro, Pennsylvania.

g. Design and Construction History. The dam was built in the 1880's, and was designed by Mr. Isaac S. Cassin, of Philadelphia, Pennsylvania. The original owner of the structure was Mr. George Brooke, owner of the E. and G. Brooke Iron Company of Birdsboro, Pennsylvania. The purpose of the dam was to supply water to the foundry and to distribute water to the workers of the plant. In 1910, the Birdsboro Water Company was organized, and the reservoir was taken over by the city water company and the supply area was extended to include the entire Borough of Birdsboro. In 1914, an inspection/evaluation report prepared by the State of Pennsylvania indicated that the dam was constructed without either a core wall or cutoff wall. The embankment materials were reported to be a mixture of sand and red clay.

On 6 July 1892, a breach occurred in the dam and a wedge-shaped portion of the embankment failed, washing out approximately 150 feet of crest. This failure was attributed to a break in the water supply pipe. The pipe was installed in the dam without antiseepage collars or a cradle. Shortly thereafter, the dam was repaired under the supervision of Mr. George Brooke.

On 22 December 1913 and 6 May 1914, the structure was examined by Mr. G. F. Wieghardt, Assistant Engineer for the State of Pennsylvania. As a result of this investigation, Mr. Wieghardt concluded that the spillway was poorly designed and should be repaired and strengthened. His recommendations included the straightening of the spillway entrance and increasing the height of the spillway walls to their present height of 4 feet. He also recommended that the embankment be graded to the same elevation as the spillway walls. These recommendations were presented to the Owner by Mr. S. Seelye, Division Engineer for the State of Pennsylvania. In 1916, the spillway entrance was enlarged under the direction of

Mr. William H. Dechant and Sons, Civil Engineers of Reading, Pennsylvania. This enlargement commenced on 16 October 1916 and was completed before the end of the year.

h. Normal Operating Procedures. Water enters the distribution system through a 12-inch pipe located at the base of the intake tower. Water is fed by gravity to a water treatment plant and distributed to the town on demand. Excess water overflows the spillway and discharges into Indian Run Creek immediately below the toe of the dam. It is understood that all valves in the 12-inch line remain in the open position and that water supply is controlled at the pumphouse.

1.3 Pertinent Data.

A summary of pertinent data for Birdsboro Reservoir is presented as follows.

a.	Drainage Area (sq. miles)	0.8
b.	Discharge at Dam Site (cfs)	
	Max. Known (June 1972)	680
	Top of Dam	1,050
c.	Elevation	
	Top of Dam	364.0[1]
	Spillway Crest	360.0
	Normal Pool	360.0
	Water Supply Inlet Invert	342.0
d.	Reservoir	
	Length at Normal Pool	1,000 feet
	Fetch at Normal Pool	1,000 feet
	Area at Normal Pool	8 acres

e.	Storage (acre-feet)	
	Normal Pool	70
	Top of Dam	92
f.	Dam Data	
	Type	Rolled earth
	Length	420 feet
	Height	40 feet
	Crest Width	12 feet
	Side Slopes (H:V)	
	Upstream	2.5:1
	Downstream	1.5:1
	Cutoff	None(2)
	Grout Curtain	None(2)
g.	Diversion	Unknown
h.	Outlet Works	
	Water Supply	
	Type	Masonry intake tower.
	Pipe Size	12 inches
i.	Spillway	
	Type	Rectangular channel, no control section.
	Width	20 feet

(1) Elevations based on 1914 drawing (Plate 2, Appendix E).

(2) As reported in Reference 1, Section 2.1.

SECTION 2
ENGINEERING DATA

2.1 Design.

a. Data Available. A summary of engineering data is presented on the checklist attached as Appendix A. Principal documents containing pertinent data used for this report are as follows.

1. "Report Upon the Indian Run Dam of Birdsboro Water Company", located on Indian Run, near Birdsboro, Berks County, Pennsylvania. Prepared by Mr. G. F. Wieghardt, dated 15 August 1914.

2. Pennsylvania State Inspection Reports from 1913 through 1970.

3. One blueprint prepared by Mr. William H. Dechant and Son, Civil Engineers, Reading, Pennsylvania, dated 1914, enclosed herein as Plate No. 2.

4. One drawing prepared by Mr. Isaac S. Cassin, dated April 1883, and presented herein as Plate No. 3.

5. Miscellaneous letters, correspondence, memos, and 11 black and white photographs of the structure.

Documents regarding the design could not be located and are believed to no longer exist. The principal source of the data presented herein is obtained from Reference No. 1 above.

b. Design Features. The principal design features have been obtained from post-construction reports, Reference No. 1, and from results of the visual inspection performed on 29 August 1978. A plan view of the dam and cross-section of the intake tower are enclosed as Plates 2 and 3, Appendix E, respectively. No cross-sections of the embankment are available. The upstream and downstream slopes presented in Section 1.3 of this report were confirmed in the field by use of an Abney level.

2.2 Construction.

Construction history data is very limited and is presented in Section 1.2.

2.3 Operation Data.

The only operational records maintained for this dam are consumption quantities used by Birdsboro customers.

2.4 Evaluation.

a. Availability. All information presented in this report was obtained from the Department of Environmental Resources (DER) files in Harrisburg, Pennsylvania or from conversations with the Owners and a review of their available files. Design and construction data could not be located. The sole source of information was obtained from Reference No. 1 of Section 2.1, paragraph a.

b. Adequacy. The available data included in the DER files and presented in this report is not adequate to evaluate the engineering aspects of this dam.

c. Validity. There is no reason to question the validity of the limited available data. The external physical features of the dam and appurtenant structures were checked in the field and agreed with the available data.

SECTION 3
VISUAL INSPECTION

3.1 Findings.

a. General. The observations and comments of the field inspection team are contained in the checklist enclosed herein as Appendix B, and are summarized and evaluated as follows. In general, the appearance of the facility indicates that the dam is currently in good condition. The dam was inspected on 29 August 1978, by a five-man team of specialists. During this inspection, Mr. Nicholas DeSantis, Chairman of the Municipal Authority, and Mr. Laverne Henry, Water Superintendent for Birdsboro Municipal Authority, were present and provided assistance.

b. Dam. There were no indications or evidence of movement of the dam observed with the exception of several small undulations of the downstream slope both vertically and horizontally. These undulations were also noted in a photograph of the downstream slope taken on 27 April 1970 by State of Pennsylvania inspectors. There appears to have been no noticable changes in the downstream slope since then. There were no unusual movements at or beyond the toe of the dam. The 3-foot high rock wall along the downstream toe is in a state of disrepair. This same condition was shown on a 6 May 1914 photograph. Therefore, it is concluded that there have been no noticable changes in the downstream slope to indicate an unstable condition.

There were no unusual movements observed along the crest of the dam, nor were there any visual signs of riprap failures on the upstream slope above the water line. The junction between the embankment and the abutment, the embankment and the spillway were carefully assessed and there were no unusual conditions observed. An area, as shown on Sheet 5a, is marshy and contains standing water. The seepage rate was judged to be on the order of 4 to 5 gpm. Apparently it has not changed since the 1940 State inspection. During this inspection, the same conditions were cited.

c. Appurtenant Structures.

1. Spillway. Since the reservoir was about 2 feet below normal pool, the entire approach channel, spillway and discharge channel could be inspected. There are no bridges or piers across the 20-foot wide spillway. The mortared hand-placed rock was inspected and observed to be in good condition. The sides of the channel are protected by a 4-foot high mortared wall, which was observed to be in good condition. It is noted that the end of the channel was damaged during Tropical Storm Agnes, June 1972, and was repaired with poured concrete in lieu of the hand-placed rock. Currently, water discharges along the left side of the channel where minor erosion is occurring.

2. Outlet Works. The tower could not be inspected as it is located in the reservoir at the upstream toe. The Owner reported that the tower has functioned satisfactorily since they assumed ownership in 1963. Approximately 15 years ago, divers entered the tower to check the condition of the intake grating and the 12-inch pipe. The Owners reported that this inspection revealed that the tower bottom and the grating were in exceptionally good condition with no accumulation of silt. Since the 12-inch pipe is completely buried between the dam and the treatment plant, the pipe could not be inspected.

d. Reservoir. Reconnaissance of the reservoir disclosed no evidence of significant siltation, slope instability, or other features that would significantly affect the flood storage capacity of the reservoir. The slopes range from flat to steep with the flat slopes at the edge of the reservoir. Recently, the edges of the reservoir have been filled in to eliminate the marshy zones along the water's edge. There are 7 active springs feeding this reservoir.

e. Downstream Channel. The valley below the dam is narrow, approximately 50 feet wide, with steep sides, and has a 20-foot drop in 550 feet. The area is densely wooded, with an access road up the valley along the creek. The first obstruction below the dam is a bridge under Hay Creek Road, approximately

0.4 miles below the dam. The culvert beneath the bridge is 9 feet deep and 7.5 feet wide. It is noted that this road was flooded during Tropical Storm Agnes. Tropical Storm Agnes is also the storm of record for this area.

There are no homes between the dam and Hay Creek Road. There are homes downstream along Hay Creek near Birdsboro. Abrupt failure of the dam would damage significant portions of Birdsboro and result in possible loss of life to many residents. It is noted that Tropical Storm Agnes destroyed 60 homes in Birdsboro.

3.2 Evaluation.

In summary, the visual survey of the dam disclosed no evidence of existing instability of the dam. However, without further investigation, an assessment of the embankment stability could not be determined.

SECTION 4
OPERATION PROCEDURES

4.1 Procedures.

Normal operating procedures do not require a dam tender. However, personnel from the Birdsboro Municipal Authority visit the site at least twice and normally three times per day. During periods of exceedingly heavy rainfall, personnel frequently inspect the dam. Under normal conditions, water is fed by gravity through an inlet at the base of the inlet tower, through a 12-inch pipe line at the base of the dam and downstream to the treatment facility. Excess water is discharged through the spillway and into Indian Run Creek.

4.2 Maintenance of the Dam.

The dam is maintained by the Birdsboro Municipal Authority and is periodically inspected by the State Department of Environmental Resources. There is no maintenance manual and maintenance is generally limited to clearing vegetation and cleaning the drainage basin adjacent to the reservoir.

4.3 Maintenance of Operating Facilities.

The maintenance of the operating facilities is performed by the Birdsboro Municipal Authority. Maintenance normally consists of clearing debris and other trash from the spillway. They also check the water from the discharge pipe to insure that it is clean and that the flow is unobstructed. The intake tower has not been inspected for approximately 15 years. It is not known if there is any debris or trash at the base of the tower which could possibly clog the system.

4.4 Warning Systems in Effect.

There are no formal warning systems or procedures established to be followed during periods of exceedingly heavy rainfall. Personnel from the water authority inspect the facility daily and are available if potentially hazardous conditions develop. The chairman of the water authority indicated that the local police would be notified in the event that an emergency condition develops.

4.5 Evaluation.

Since no written operating procedures exist at this time, a procedure should be developed. Maintenance procedures should also be developed and incorporated into the operating procedures. The procedures should include a checklist of items to be inspected during the inspection of the dam and outlet works.

Since a formal warning procedure does not exist, a formal procedure should be developed and implemented during periods of extreme rainfall. This procedure should consist of a detailed method of notifying residents along Hay Creek and further downstream in Birdsboro.

SECTION 5
HYDROLOGY/HYDRAULICS

5.1 Evaluation of Features.

a. Design/Evaluation Data. No original design data exists and only a few statements concerning the spillway capacity are included in the inspection/ investigation report prepared by the State of Pennsylvania in 1914.

The watershed is small, about 0.8 miles long and 1.1 miles wide, having a total area of 0.8 square miles. Elevations range from about 830 feet to 360 at normal pool elevation. The average watershed slope is about 12 percent. The reservoir is fed by seven springs. The watershed is 100 percent wooded and is entirely owned by the Water Authority. Runoff characteristics are not expected to change in the foreseeable future.

The 1914 report evaluated the spillway capacity to be about 300 cfs with a depth of flow of 3 feet, and 425 cfs with a depth of flow of 4 feet. The report also stated that the spillway capacity was not adequate to meet the then existing standards. The State directed that the entrance to the channel be enlarged and the spillway wall repaired, which increased the capacity of the channel.

In accordance with the criteria established by the Federal (OCE) Guidelines, the recommended spillway design flood for this "Intermediate" size dam and "High" hazard potential classification is the probable maximum flood (PMF).

b. Experience Data. No reservoir water level records or precipitation records are kept. It is reported that the depth of flow in the spillway channel during Tropical Storm Agnes, June 1972, was about 3 feet, an estimated discharge of 680 cfs. Weather Bureau Publications indicate about 6.6 inches of rain in a two day period for this general area.

c. Visual Observations. On the date of the inspection, there were no conditions observed that would indicate a reduced spillway capacity during a flood occurrence. Spillway dimensions were checked and noted that the minimum height of the spillway wall is 27 inches at the point where the spillway floor ends and discharge falls into the wasteway channel. The wall gradually increases in height to 4 feet at the crest of the dam. Other observations regarding the condition of the downstream channel, spillway and reservoir are located in Appendix B.

d. Overtopping Potential. The overtopping potential of this dam was estimated from approximate methods, as shown in Appendix C. Calculations indicate that the maximum spillway capacity is 440 cfs when the depth of flow is 27 inches, the minimum height of the spillway wall. The estimated peak PMF inflow is 1,830 cfs. It is estimated that the spillway can pass 25 percent of the PMF storm without overtopping the spillway wall.

The right spillway wall is cut into the abutment and an access road is adjacent to the spillway. Flow over the wall and road is not expected to result in failure of the wall although some erosion is expected. The left spillway wall is cut into erosion resistant materials. Flow over this wall would result in some erosion, but the risk of failure of the dam as a result of this overtopping is considered to be low. The spillway discharge is estimated to be 1,050 cfs with the reservoir level at the top of the dam. The spillway would then be capable of discharging 61 percent of the PMF storm without overtopping the structure.

e. Spillway Adequacy. The spillway system is "Inadequate", but not "Seriously Inadequate", as the dam will pass more than 50 percent of the PMF storm without overtopping the embankment. The tailwater is estimated to be 30 feet or more below the top of the dam with a minimum spillway discharge of 1,050 cfs.

f. Downstream Conditions. The dam is located on Indian Run about 0.5 miles above its confluence with Hay Creek. There are no houses or buildings between the dam and Hay Creek. About 400 feet before entering Hay Creek, Indian Run passes under Hay Creek Road. The bridge is estimated to have a capacity of

430 cfs. Potential damage sites are located downstream along Hay Creek, particularly in Birdsboro.

The treatment plant is located near the confluence of Indian Run with Hay Creek and would be damaged in the event of failure. There are homes along Hay Creek above Birdsboro and many more along the creek in Birdsboro. Failure of the dam would cause damage in Birdsboro and result in possible loss of life. Therefore, a "High" hazard potential classification is justified.

SECTION 6
STRUCTURAL STABILITY

6.1 Evaluation of Structural Stability.

a. Visual Observations. The visual observations did not indicate any existing embankment stability problems. There were downstream slope undulations and seepage noted at the downstream toe. However, these slope undulations were noted in the photograph taken in 1970. The downstream slope seepage was noted in 1914, and from the description of the seepage, there has apparently been no change in flow rates for approximately 64 years. Therefore, the seepage is not judged to be associated with piping or potential foundation failure.

The spillway is judged to be in fairly good condition with stable side channels and chute. The exit channel, which was repaired in 1972 after Tropical Storm Agnes, is in good condition but should be inspected after passage of large discharges. Since the access tower was inaccessible, this system could not be evaluated. However, it has apparently operated satisfactorily since 1884 and, therefore, it is assumed that it is in a stable condition. The base of the tower should be checked for trash and debris. The structural integrity of the tower should be checked.

b. Design and Construction Data. There was no design or construction data available. All data concerning physical features of the dam have been determined from a 1914 report or from miscellaneous letters and correspondence in the Department of Environmental Resources (DER) files. The Owner's files were reviewed and no additional data could be found.

c. Operating Procedures. There are no written operating procedures for this dam.

d. Post-Construction Changes. The only post-construction change reported was the reconstruction of the spillway in 1914. The spillway channel walls were raised from 3 to 4 feet. The spillway channel entrance was straightened. Several stepping stones across the channel were removed because they collected trash.

e. Seismic Stability. The dam is located in Seismic Zone 1. Normally, it can be considered that if a dam in this zone is stable under static loading conditions, it can be assumed safe for any expected earthquake conditions. Since the static factor of safety for this dam is unknown, a seismic stability evaluation could not be made.

SECTION 7
ASSESSMENT/REMEDIAL MEASURES

7.1 Dam Assessment.

a. Evaluation. The visual inspection indicates that the dam is in good condition. There is no engineering or construction data available, other than information contained in a post-construction investigation and that obtained from conversations with the current owners. The downstream slope, although it is relatively steep, 1.5H:1V, appears to be stable with no movement occurring. The outlet works are approximately 94 years old and have apparently been operating satisfactorily since completion, with the exception of the failure that occurred in 1892. This failure was judged to have resulted from pipe failure due to poor construction.

The spillway capacity is judged to be "Inadequate" using Corps of Engineers criteria, as the dam will be overtopped by the PMF. Overtopping of the embankment would occur at approximately 61 percent of the probable maximum flood. Therefore, the spillway is not judged "Seriously Inadequate", as it will pass 0.5 PMF.

The seepage noted at the downstream slope has been there since at least 1914 and, based on the descriptions in existing DER files, seepage has remained unchanged for the past 64 years. Based on this assessment, it is concluded that the seepage is not evidence of an imminent failure. It is also noted from local geologic evaluations, and the results of a 1914 inspection, that this particular area is riddled with local springs, which often produce small, localized marshy zones. This seepage could be associated with local springs.

b. Adequacy of Information. There was insufficient engineering construction data available to adequately evaluate the stability of the dam or the

service life of the outlet works. Specifically, there is no substantial data delineating the types of materials used for construction. It is reported that sand and red clay was probably used. The interior features of the dam including the existence of drainage systems is unknown. It is believed that there are no drainage systems, cutoff trenches or grout curtains incorporated in this embankment.

c. Urgency. It is concluded that the recommendations presented in Section 7.2 be implemented as soon as practical.

7.2 Remedial Measures.

a. Facilities. The following recommendations are presented in order of priority and should be undertaken by the Owner as soon as practical.

1. The pond drain system should be checked to insure that the reservoir can be drained in the event of an emergency.

2. The water at the base of the dam is considered undesirable and should be checked to determine of it is a natural marsh area or seepage through the dam. This can be accomplished by regrading the toe of the dam and evaluating the seepage locations. If underseepage is determined to be occurring, an inverted filter blanket should be installed.

3. The intake structure should be inspected for debris and stability.

4. A valve should be installed in the tower to enable emergency closure of the water supply pipe in the event a leak develops in the pipe beneath the embankment.

b. Operation and Maintenance Procedures. Formal operation, maintenance and warning procedures should be developed. The warning procedures should

include a method of warning downstream residents when high flows are expected. Evacuation procedures should also be developed.

The Owner should develop an inspection checklist as an amendment to the maintenance procedure to insure that all critical items are inspected and maintained on a periodic basis.

APPENDIX

A

CHECK LIST
ENGINEERING DATA
DESIGN, CONSTRUCTION, OPERATION
PHASE I

NAME OF DAM *Birdsboro Reservoir (Indian Run Dam)*

ID # *PA 00713*

ITEM	REMARKS
AS-BUILT DRAWINGS	*None.*
REGIONAL VICINITY MAP	*See Plate 1, Appendix E of this report.*
CONSTRUCTION HISTORY	*Some limited construction history was found in the files principally in Document No. 1 under the heading entitled "Miscellaneous". See Sheet 4 of 4. A description of construction is located in the text of this report.*
TYPICAL SECTIONS OF DAM	*None.*
OUTLETS - PLAN	*None.*
DETAILS	
CONSTRAINTS	
DISCHARGE RATINGS	
RAINFALL/RESERVOIR RECORDS	*No rainfall records in the area.*

ITEM	REMARKS
DESIGN REPORTS	1. *Mr. William H. Dechant & Son, Civil Hydraulic Engineers, Reading, Pennsylvania was the design engineer in 1914 but no report was in DER files.* 2. *No other reports are available.*
GEOLOGY REPORTS	*None. However, a description of the local geology is presented in Appendix E of this report.*
DESIGN COMPUTATIONS HYDROLOGY & HYDRAULICS DAM STABILITY SEEPAGE STUDIES	*None available.*
MATERIALS INVESTIGATIONS BORING RECORDS LABORATORY FIELD	*None available.*
POST-CONSTRUCTION SURVEYS OF DAM	*None.*
BORROW SOURCES	*Unknown.*

ITEM	REMARKS
MONITORING SYSTEMS	*None.*
MODIFICATIONS	*In 1914 a request was made to increase the storage capacity by one foot. This was denied because of the leakage through the downstream embankment.*
HIGH POOL RECORDS	*None*
POST CONSTRUCTION ENGINEERING STUDIES AND REPORTS	*None.*
PRIOR ACCIDENTS OR FAILURE OF DAM DESCRIPTION REPORTS	*Yes.*
MAINTENANCE OPERATION RECORDS	*None.*

ITEM	REMARKS
SPILLWAY PLAN	*- A 1914 plan of the spillway was located in the DER files.*
SECTIONS	*None.*
DETAILS	*None.*
OPERATING EQUIPMENT PLANS & DETAILS	*None.*
MISCELLANEOUS	*1. "Report Upon the Application of the Indian Run Dam of the Birdsboro Water Company". Report No. 58 date 15 August 1914.* *2. 8 B&W photographs dated 1914, 3 B&W photographs dated 1970, 3 B&W photographs dated 1959.* *3. Application dated September 1914 to enlarge the spillway.* *4. Inspection reports from 1914 through 1970 prepared by the State.*

APPENDIX

B

CHECK LIST
VISUAL INSPECTION
PHASE I

Name Dam Indian Run Dam (Birdsboro Reservoir) County Berks State Pennsylvania National ID # PA 00713

Type of Dam Earth Hazard Category I (High)

Date(s) Inspection 29 Aug. 1978 Weather Partly cloudy Hot, Humid Temperature 80's

Pool Elevation at Time of Inspection 368.6 M.S.L. Assumed from city drawings. Tailwater at Time of Inspection N/A M.S.L.

Inspection Personnel:

Mary Beck (Hydrologist)
Ray Lambert (Geologist)
John H. Frederick, Jr. (Geotechnical)
Vince McKeever (Hydrologist)
John Boschuk, Jr. (Geotechnical/Civil)

John Boschuk, Jr. Recorder

Remarks:

Mr. Nicholas DeSantis - Chairman of Municipal Authority
Mr. Lavern Henry - Water Superintendent
were on site and provided assistance during the inspection.

CONCRETE/MASONRY DAMS

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
ANY NOTICEABLE SEEPAGE	*N/A*	
STRUCTURE TO ABUTMENT/EMBANKMENT JUNCTIONS	*N/A*	
DRAINS	*N/A*	
WATER PASSAGES	*N/A*	
FOUNDATION	*N/A*	

CONCRETE/MASONRY DAMS

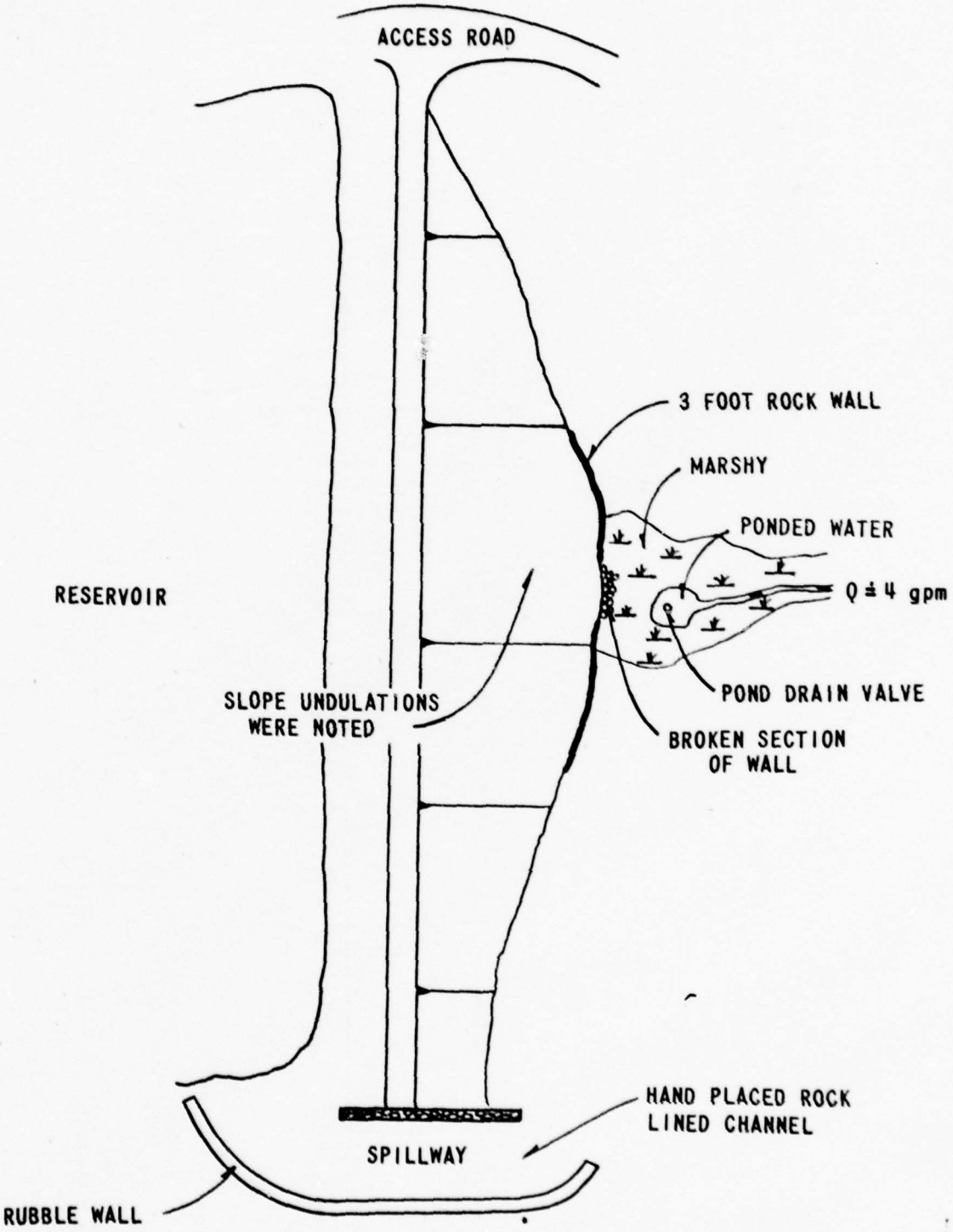
VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SURFACE CRACKS CONCRETE SURFACES	*N/A*	
STRUCTURAL CRACKING	*N/A*	
VERTICAL AND HORIZONTAL ALIGNMENT	*N/A*	
MONOLITH JOINTS	*N/A*	
CONSTRUCTION JOINTS	*N/A*	

EMBANKMENT

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SURFACE CRACKS	None observed.	
UNUSUAL MOVEMENT OR CRACKING AT OR BEYOND THE TOE	No unusual movement but the rock wall at the toe (three feet high) showed evidence of very minor downslope movements.	
SLOUGHING OR EROSION OF EMBANKMENT AND ABUTMENT SLOPES	Some vertical and horizontal undulations were noted on the downstream side of the slope and the lower one third was damp but no seepage was observed through the embankment. See sheet 5a.	
VERTICAL AND HORIZONTAL ALIGNMENT OF THE CREST	No unusual movements were observed along the crest.	
RIPRAP FAILURES	None	

EMBANKMENT

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
JUNCTION OF EMBANKMENT AND ABUTMENT, SPILLWAY AND DAM	*No unusual conditions observed.*	
ANY NOTICEABLE SEEPAGE	*An area as shown on sheet 5a is marshy and contains standing water. Seepage flow was judged to be on the order of four to five gpm. The pond drain valve stem was located at the base of the dam in the marshy area. As discussed on sheet 4, dampness was noted on the downstream slope of the embankment.*	
STAFF GAGE AND RECORDER	*None*	
DRAINS	*None known.*	



SEEPAGE LOCATION PLAN
INDIAN RUN DAM
(BIRDSBORO RESERVOIR)

SHEET 5a OF 11

OUTLET WORKS

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CRACKING AND SPALLING OF CONCRETE SURFACES IN OUTLET CONDUIT	*Could not be observed.*	
INTAKE STRUCTURE	*No access to the structure but two feet of the tower was exposed above the water level and this was judged to be in good condition.*	
OUTLET STRUCTURE	*Buried pipe to town of Birdsboro and could not be inspected.*	
OUTLET CHANNEL	*None*	
EMERGENCY GATE	*None. The low intake pipe at the base of the intake tower serves as a water supply pipe but can be used as a pond drain.*	

UNGATED SPILLWAY

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONCRETE WEIR	*None*	
APPROACH CHANNEL	*None. The reservoir discharges directly into a channel of hand placed riprap. The sides of the channel are protected by a mortar wall.*	
DISCHARGE CHANNEL	*The hand placed rock channel is in good condition. The end of the channel was damaged during Tropical Storm Agnes (June 1972) and was repaired using concrete in lieu of the hand placed rock. Currently, discharge passes along the left side of the the channel where minor erosion is occurring. This area should be inspected after severe storms.*	
BRIDGE AND PIERS	*None.*	

GATED SPILLWAY

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONCRETE SILL	*None*	
APPROACH CHANNEL	*None*	
DISCHARGE CHANNEL	*None*	
BRIDGE AND PIERS	*None*	
GATES AND OPERATION EQUIPMENT	*None*	

INSTRUMENTATION

VISUAL EXAMINATION	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
MONUMENTATION/SURVEYS	*None*	
OBSERVATION WELLS	*None*	
WEIRS	*None*	
PIEZOMETERS	*None*	
OTHER	*None*	

RESERVOIR

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SLOPES	*Moderate to steep with more moderate slopes at the edge of the reservoir. The edge of the reservoir has been filled to remove the marshy area. There are seven active springs feeding into the reservoir.*	
SEDIMENTATION	*Sedimentation is judged to be very slight. There is no affect on flood storage.*	

DOWNSTREAM CHANNEL

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONDITION (OBSTRUCTIONS, DEBRIS, ETC.)	*The valley below the dam narrows with steep sides and has a 20 foot drop in 550 feet. Densely woody with an access road up the valley to the dam. The first obstruction is the bridge across Hay Creek Road approximately .75 miles below the dam. The culvert is nine feet deep and seven and a half feet wide. This road was flooded during Tropical Storm Agnes.*	
SLOPES	*Side slopes adjacent to the stream range from near vertical to one and a half to one. The flood plain width averages 50 feet wide with variable side slopes. The valley is densely wooded.*	
APPROXIMATE NO. OF HOMES AND POPULATION	*There are no homes between the dam and Hay Creek Road. Closer to Birdsboro, there are homes along Hay Creek. Approximately 3600 water customers in Birdsboro. Abrupt failure of the dam would damage Birdsboro and result in possible loss of life. Tropical Storm Agnes destroyed 60 homes in Birdsboro.*	

APPENDIX

C

BIRDSBORO RESERVOIR
CHECK LIST
HYDROLOGIC AND HYDRAULIC
ENGINEERING DATA

DRAINAGE AREA CHARACTERISTICS: *100% wooded, no residential development.*

ELEVATION TOP NORMAL POOL (STORAGE CAPACITY): *360.0* (70 Acre-Feet).*

ELEVATION TOP FLOOD CONTROL POOL (STORAGE CAPACITY): *364.0* (92 Acre-Feet).*

ELEVATION MAXIMUM DESIGN POOL: -----

ELEVATION TOP DAM: *364.0**

SPILLWAY

a. Elevation *360.0**

b. Type *Rectangular channel with drop off at end.*

c. Width *20'*

d. Length *84'*

e. Location Spillover *Right abutment.*

f. Number and Type of Gates *None.*

OUTLET WORKS:

a. Type *Masonry tower.*

b. Location *Upstream toe about midway along the center line.*

c. Entrance inverts *Base of tower - 12 inch pipe.*

d. Exit inverts *N/A*

e. Emergency draindown facilities *Same pipe as water supply outlet works.*

HYDROMETEOROLOGICAL GAGES:

a. Type *None.*

b. Location

c. Records

MAXIMUM NON-DAMAGING DISCHARGE: *430 cfs-estimated capacity of downstream bridge.*

**Elevations based on a 1914 drawing.*

DAM SAFETY ANALYSIS
HYDROLOGIC/HYDRAULIC DATA

Date: 9/10/78
By: HEB
Sheet: 2 of 9

DAM Birdsboro Reservoir Nat. ID No. PA00713 DER No. 6-6

	ITEM/UNITS	Permit/Design Files (A)	Calc. from Files/Other (B)	Calc. from Observations (C)
1.	Min. Crest Elev., ft.			
2.	Freeboard, ft.			
3.	Spillway(1) Crest Elev, ft.			
3a.	Secondary(2) Crest Elev, ft.			
4.	Max. Pool Elev., ft.			
5.	Max. Outflow(3), cfs			
6.	Drainage Area, mi^2	0.8		0.85
7.	Max. Inflow(4), cfs			
8.	Reservoir Surf. Area, Acre	5.0		8.0
9.	Flood Storage(5), Acre-Feet			
10.	Inflow Volume, ft^3			

Reference all figures by number or calculation on attached sheets:

Example: 3A - Drawing No. xxx by J. Doe, Engr., in State File No. yyyy.

NOTES:

(1) Main emergency spillway.

(2) Secondary ungated spillway.

(3) At maximum pool, with freeboard, ungated spillways only.

(4) For columns B, C, use PMF.

(5) Between lowest ungated spillway and maximum pool.

Date: 9/10/78
By: MFB
Sheet: 3 of 9

HYDROLOGIC/HYDRAULIC CALCULATIONS (cont.)

Item (from Sheet 2)	Source
6A	Inspection/Evaluation Report dated Aug. 15, 1914, prepared by State
8A	Letter from Birdsboro Water Co. to State, dated Jan. 21, 1949
6C, 8C	USGS Map Elverson, Pa. (1969)

BY MEB DATE 9/10/78 SUBJECT Birdsboro Reservoir Hydrology / Hydraulics SHEET 4 OF 9

CHKD. BY ____ DATE ____ JOB No. ____

Classification (Ref.- Recommended Guidelines for Safety Inspection of Dams)

1. The hazard potential is rated as "High" as there would be loss of life if the dam failed.

2. The size classification is "Intermediate" based on its 40 ft height.

3. The spillway design flood, based on size and hazard classification, is the probable maximum flood (PMF).

Hydrology and Hydraulic Analysis

1. Original / Evaluation Data - statements contained in a Aug. 15, 1914 inspection/evaluation of the dam by the State

Drainage area = 0.8 sq. mile

Spillway capacity - based on open channel flow
Q = 296 cfs w/ normal depth (d_n) = 3 ft
(considered inadequate)
Q = 425 cfs w/ d_n = 4 ft.

spillway width = 20 ft
length = 84 ft
slope = 1/84 = 0.012

spillway bottom - cement rubble
walls - dry rubble

2 Evaluation

Drainage area - 0.8 sq. mile supported by current USGS Map

Spillway capacity, Qa
Dimensions field checked
width - 20 ft; length - 84 ft; slope 0.012
n - coefficient of roughness - 0.025

BY MEB DATE 5/10/78 SUBJECT Birdsboro Reservoir Hydrology / Hydraulics SHEET 5 OF 9

CHKD. BY DATE JOB No

Depth of spillway channel
- the minimum depth is on the left channel wall at the point of drop-off = 27" (2.25 ft)
- depth of wall at ℄ of dam is 4± ft.

Assume critical flow at drop-off
Critical depth, d_c = 2.25 ft.

$Q_c = \sqrt{g}\, b\, d_c^{3/2}$ - Brater & King Handbook of Hydraulics Eq. 8-29

$= \sqrt{g} \cdot 20 \cdot 2.25^{3/2}$

$Q_c = 383$ cfs

d_n for $Q = 383$ cfs - Manning's Eq

$Q = b \cdot d_n \frac{1.486}{n} \left(\frac{b \cdot d_n}{b + 2d_n}\right)^{2/3} S^{1/2}$

if $d_n = 2.05$ ft

$383 \stackrel{?}{=} 20 \cdot 2.05 \frac{1.486}{0.025} \left(\frac{20 \cdot 2.05}{20 + 2 \cdot 2.05}\right)^{2/3} 0.012^{1/2}$

$383 \sim 380$

Therefore, $d_n = 2.05$ ft $< d_c = 2.25$ ft and flow is supercritical (just barely) and discharge capacity of spillway can be approximated by Manning's Eq.

Q for $d_n = 2.25$ ft

$= 20 \cdot 2.25 \frac{1.486}{0.025} \left(\frac{20 \cdot 2.25}{20 + 2 \cdot 2.25}\right)^{2/3} 0.012^{1/2}$

≈ 440 cfs

If spillway wall was increased to 4 ft

$Q = 20 \cdot 4 \frac{1.486}{0.025} \left(\frac{20 \cdot 4}{20 + 2 \cdot 4}\right)^{2/3} 0.012^{1/2}$

$Q \sim 1050$ cfs

BY MFB DATE 9/10/78 SUBJECT Birdsboro Reservoir SHEET 6 OF 9

CHKD. BY DATE Hydrology / Hydraulics JOB No

Peak PMF Inflow, Q_I

Information from Corps of Engineers, Balt. District indicates a comparable watershed is on Allegheny Creek. D.A. = 10 sq. mile & est. peak PMF of 13,280 cfs

$$Q_I = \left(\frac{0.8}{10}\right)^{0.8} 13{,}280 = 1827$$

SAY 1830 cfs

Volume of Inflow, V_I

PMP = 25.5 in. from Weather Service Paper TP-40

assume 90% runoff

$$V_I = \frac{0.9 \cdot 25.5}{12} 0.8 \cdot 640 \approx 980 \text{ Ac-Ft.}$$

Available flood storage, V_S

is surface area of reservoir x height

8 x 2.25 = 18 Ac-Ft under existing conditions

8 x 4 = 32 Ac-ft if spillway wall height increased to 4 ft.

Overtopping potential - see sheets 8 & 9

Required storage $V_R = \left(1 - \frac{Q_o}{Q_I}\right) V_I$

(As a triangular inflow hydrograph is used, $Q_{I_x} = x\,Q_I$; $V_{I_x} = x\,V_I$)

0.5 PMF

Q_o = 440 cfs w/o spilling over left wall

$$V_R = \left(1 - \frac{440}{0.5 \cdot 1830}\right) 0.5 \cdot 980$$

$$= 254 \text{ Ac-Ft} > V_S = 18$$

Q_o = 1050 cfs w/ discharge spilling over left wall.

$Q_o > Q_I = 945$ cfs

Percentage of PMF passed w/o spilling over left wall

$$18 = \left(1 - \frac{440}{X \cdot 1830}\right) X \cdot 980$$
$$X = 25\%$$

Percentage of PMF passed w/ overtopping embankment

$$32 = \left(1 - \frac{1050}{X 1830}\right) X 980$$
$$X = 61\%$$

Spillway Adequacy - see text for discussion

Downstream Conditions

First Downstream Bridge is 7.5 ft x 9 ft high. Distance Between top & bottom of bridge is 1 foot.

Capacity is estimated by use of an orfice eq.

$Q = C a \sqrt{2gH}$ Nat. Engineering Handbook, Sect. 4, Eq.

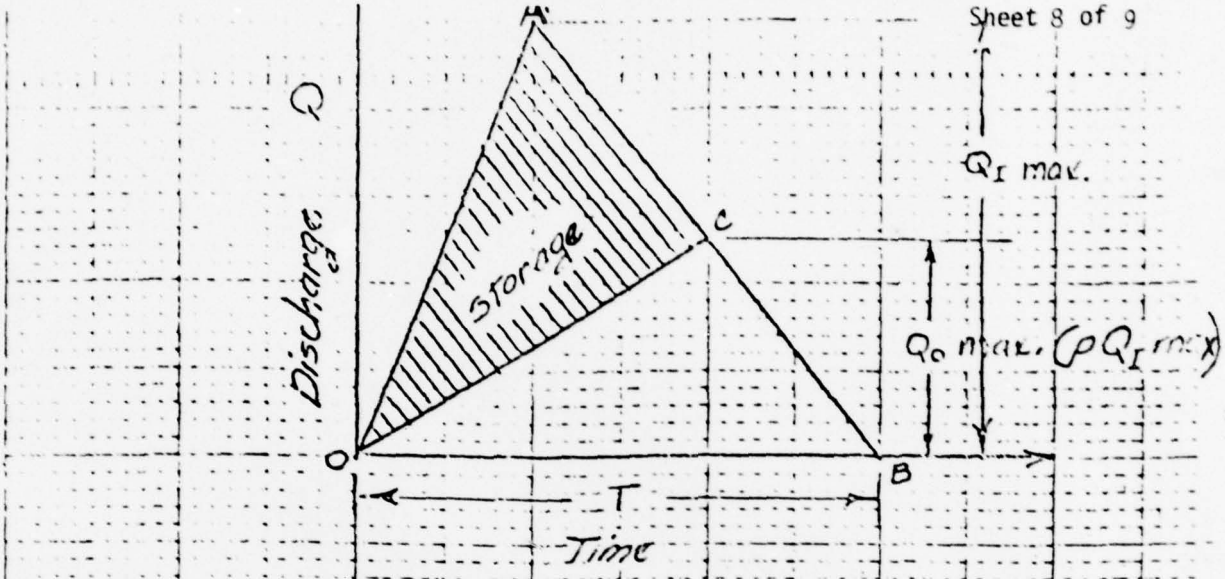
a = area, $7.5 \times 9 = 67.5$ ft²

C = coefficient - ranges between 0.7 & 0.9 average is 0.8

H = head, distance between headwater & tailwater surfaces

As Tropical Storm Agnes is reported to have made the road impassable, use H = 1 ft.

$$Q = 0.8 \cdot 67.5 \sqrt{2g \cdot 1}$$
$$\approx 430 \text{ cfs}$$



PURPOSE: Establish relationship between maximum spillway discharge and storage required to pass flood hydrograph without exceeding maximum pool level.

$$\frac{\Delta AOC}{\Delta AOB} = \frac{\Delta AOB - \Delta COB}{\Delta AOB} = 1 - \frac{\Delta COB}{\Delta AOB}$$

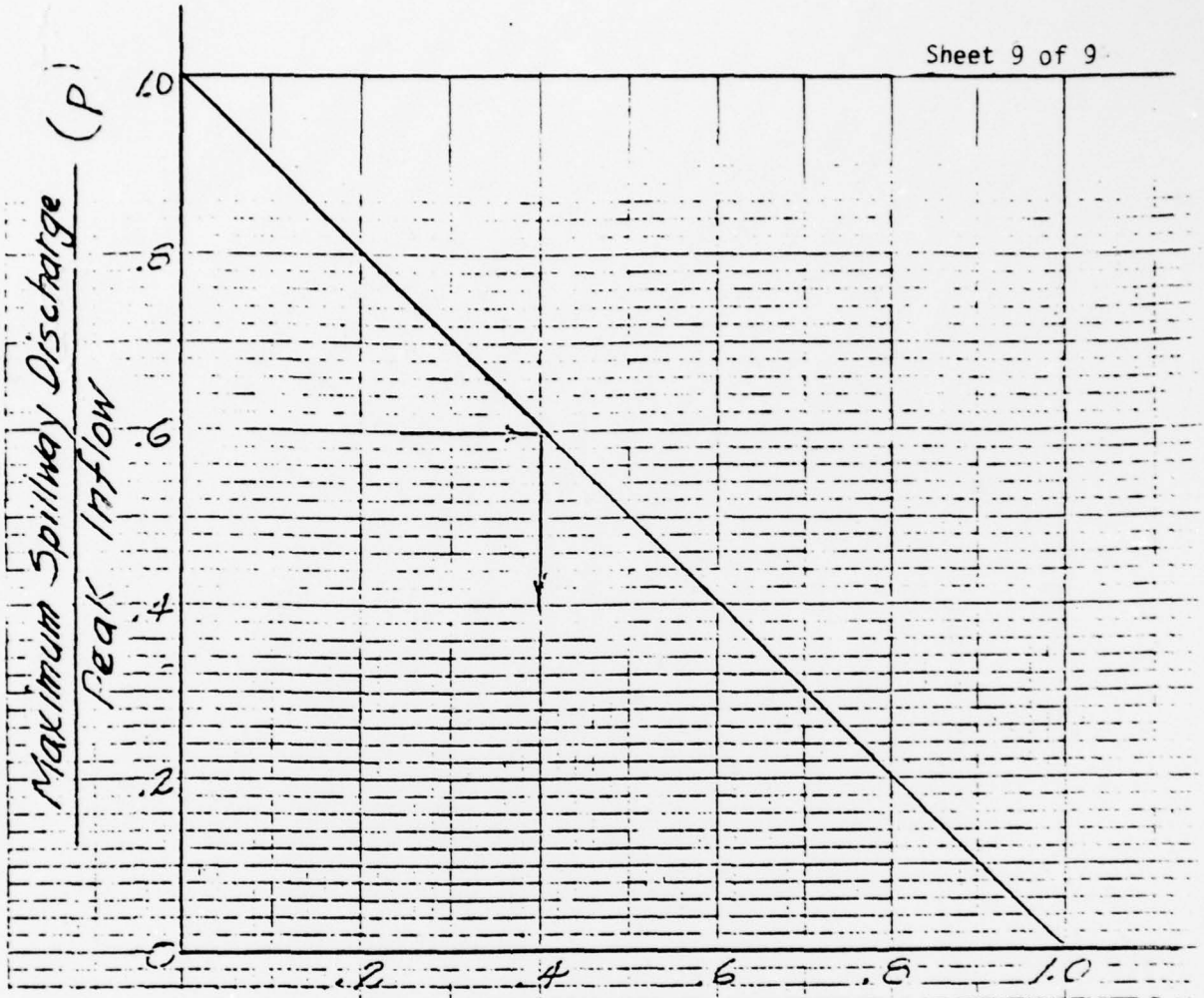
$$\frac{\Delta AOC}{\Delta AOB} = 1 - \frac{T\,\rho Q_{I\,max}/2}{T\,Q_{I\,max}/2} = 1 - \rho$$

$$\Delta AOC = (1-\rho)\,\Delta AOB \quad \text{where } 0 \le \rho \le 1.0$$

ρ	ΔAOC
1.00	0
0.75	0.25 ΔAOB
0.50	0.50 ΔAOB
0.25	0.75 ΔAOB
0	1.00 ΔAOB

REFERENCE

PRELIMINARY ENGINEER TECHNICAL LETTER NO. 1110-2- 25 January 1978



Steps to obtain required reservoir to pass inflow hydrograph without overtopping dam.

1. Obtain maximum spillway discharge
2. Develop inflow hydrograph
3. Compute relationship of maximum spillway capacity to peak inflow
4. Read relationship of required reservoir storage to volume of inflow hydrograph from curve

APPENDIX

D

VIEW LOOKING ALONG DAM CREST FROM THE
SPILLWAY TOWARDS THE LEFT ABUTMENT.

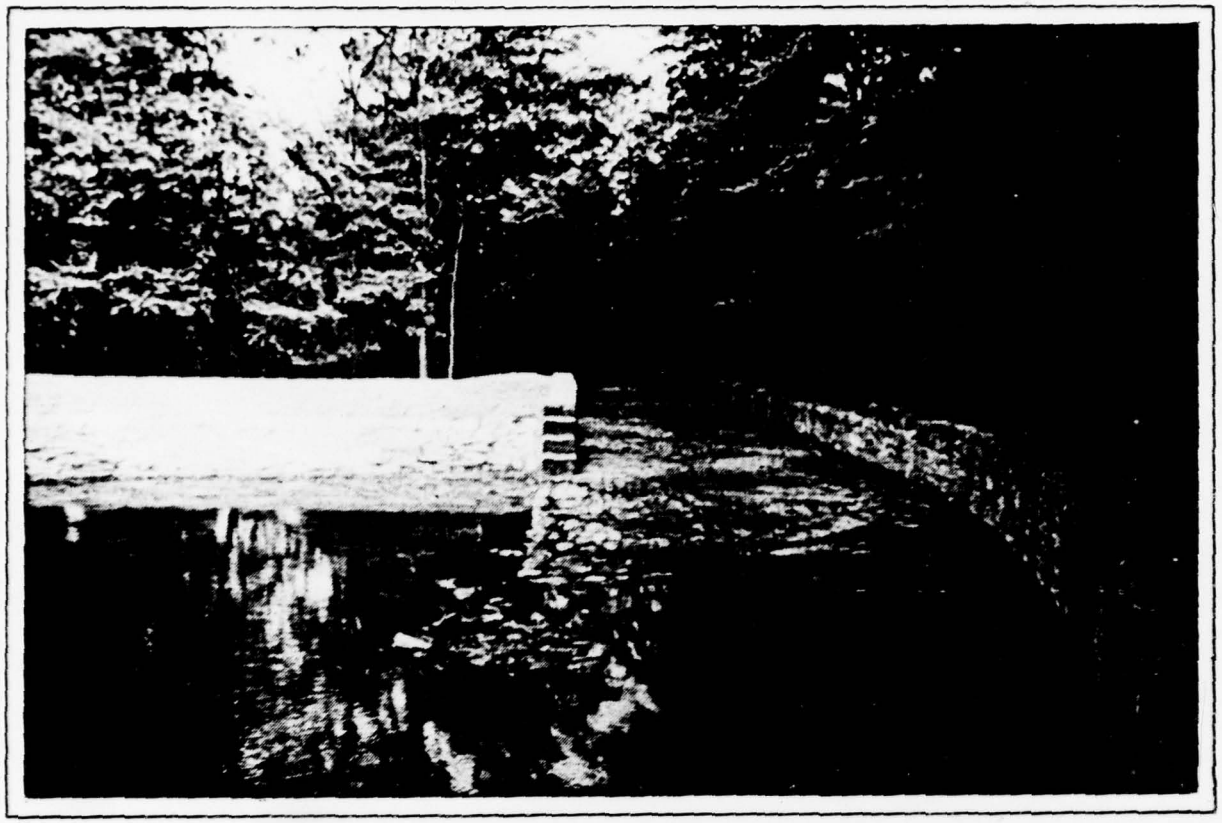
PHOTOGRAPH NO. 1

POND DRAIN VALVE LOCATED IN POOL OF
WATER JUST BEYOND DOWNSTREAM TOE.
SEE SHEET 5a, APPENDIX B.

PHOTOGRAPH NO. 2

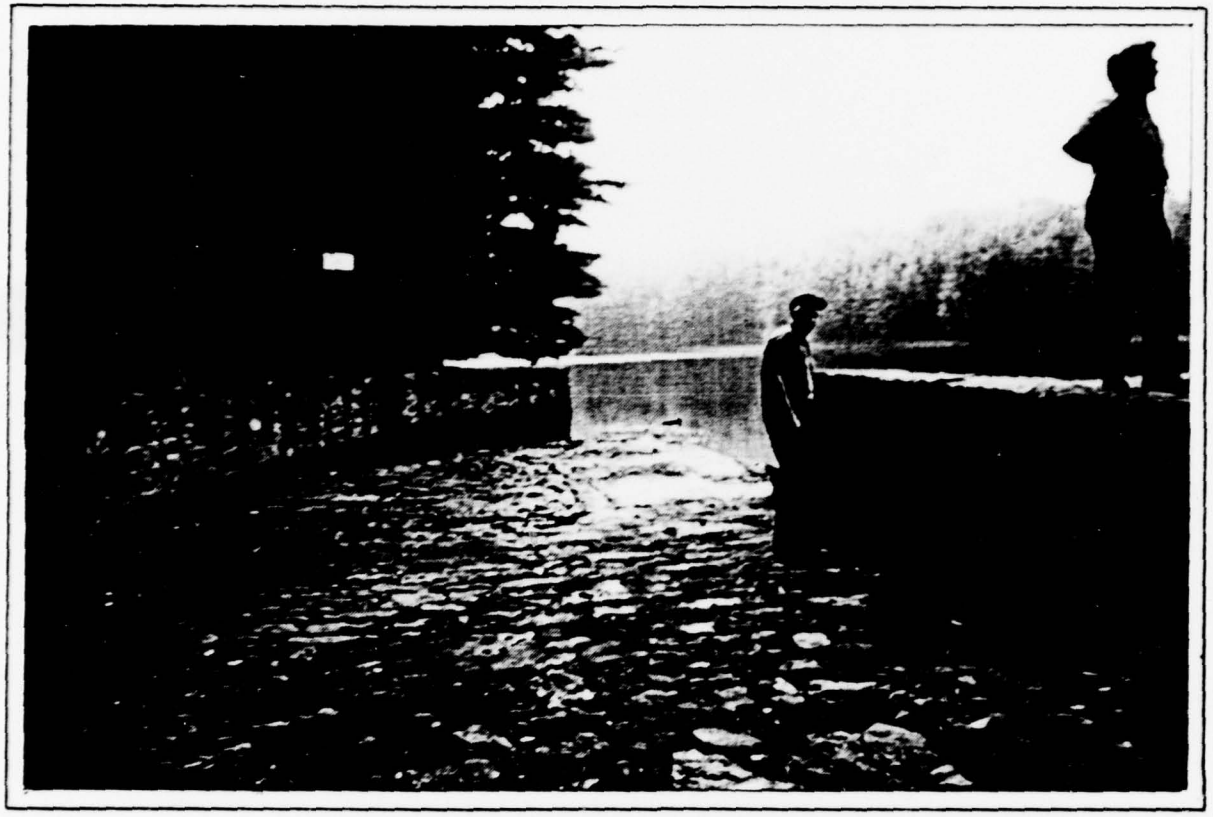
LOOKING DOWNSTREAM OF THE SPILLWAY CHANNEL.

PHOTOGRAPH NO. 3



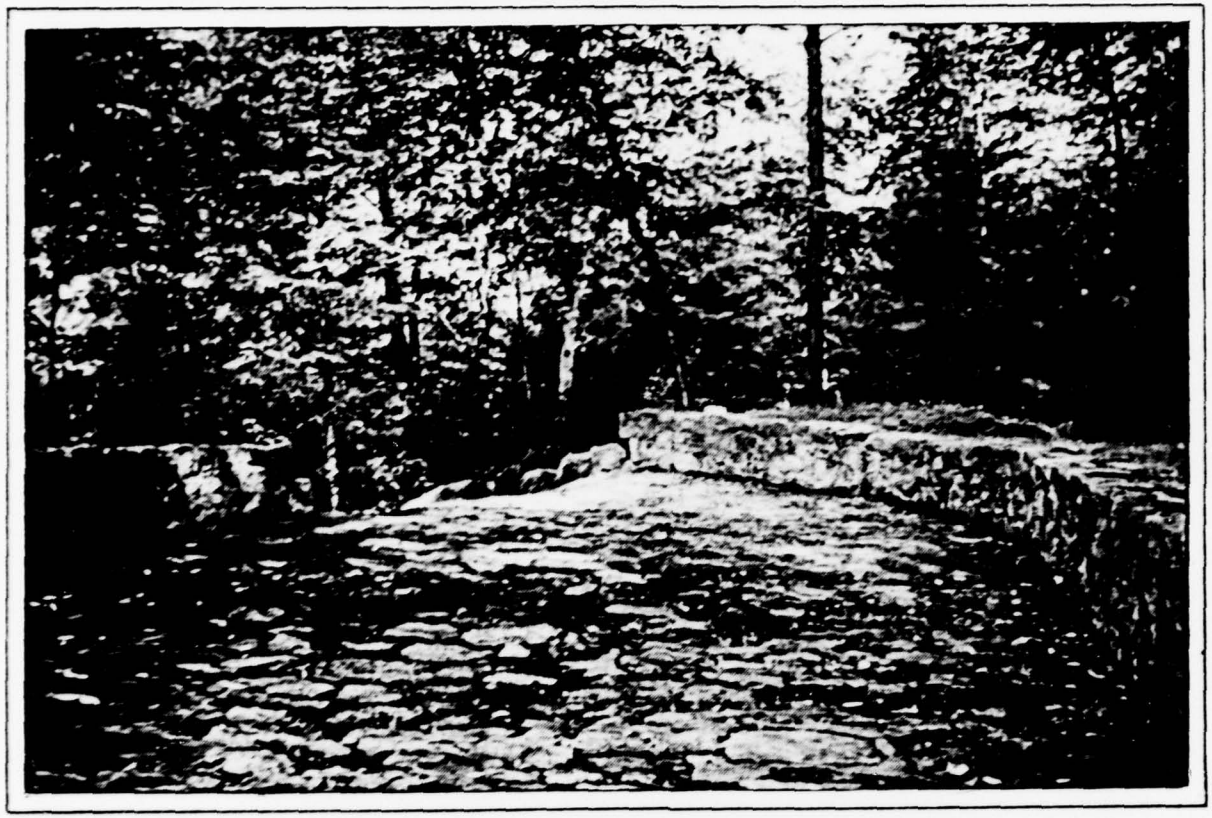
OVERVIEW OF SPILLWAY LOOKING
DOWNSTREAM.

PHOTOGRAPH NO. 4



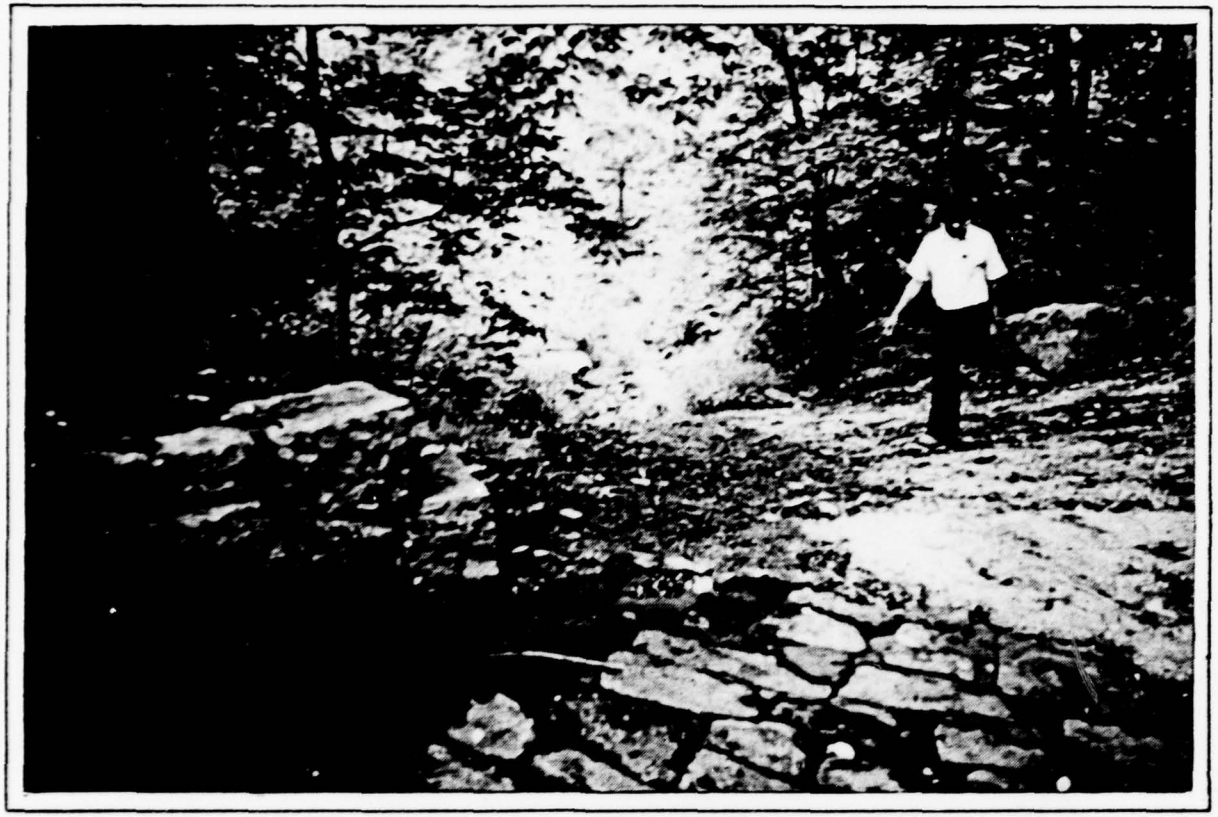
LOOKING UPSTREAM THROUGH SPILLWAY
CHANNEL.

PHOTOGRAPH NO. 5



SPILLWAY EXIT INTO THE NATURAL STREAM CHANNEL. LOWER SECTION OF SPILLWAY WAS RECONSTRUCTED WITH CONCRETE AFTER BEING DAMAGED BY TROPICAL STORM AGNES, JUNE 1972.

PHOTOGRAPH NO. 6

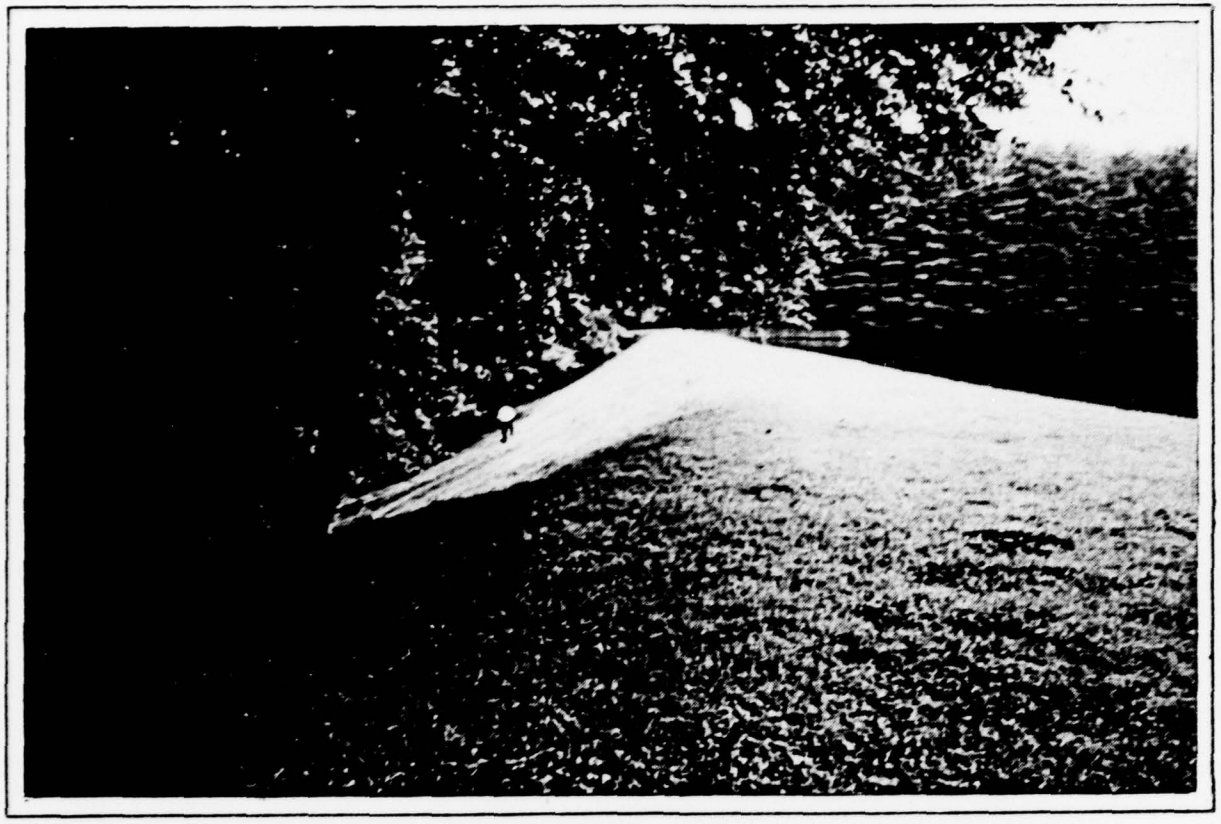


REFERENCE INFORMATION ON PHOTOGRAPH
NUMBER 6. NOTE CONCRETE REPAIRS.

PHOTOGRAPH NO. 7

VIEW OF UPSTREAM HAND PLACED
RIPRAP SLOPE PROTECTION.

PHOTOGRAPH NO. 8



OVERVIEW OF DOWNSTREAM SLOPE
LOOKING TOWARDS RIGHT ABUTMENT.

PHOTOGRAPH NO. 9

OVERVIEW OF LOWER PORTION OF
DOWNSTREAM SLOPE LOOKING TOWARDS
LEFT ABUTMENT.

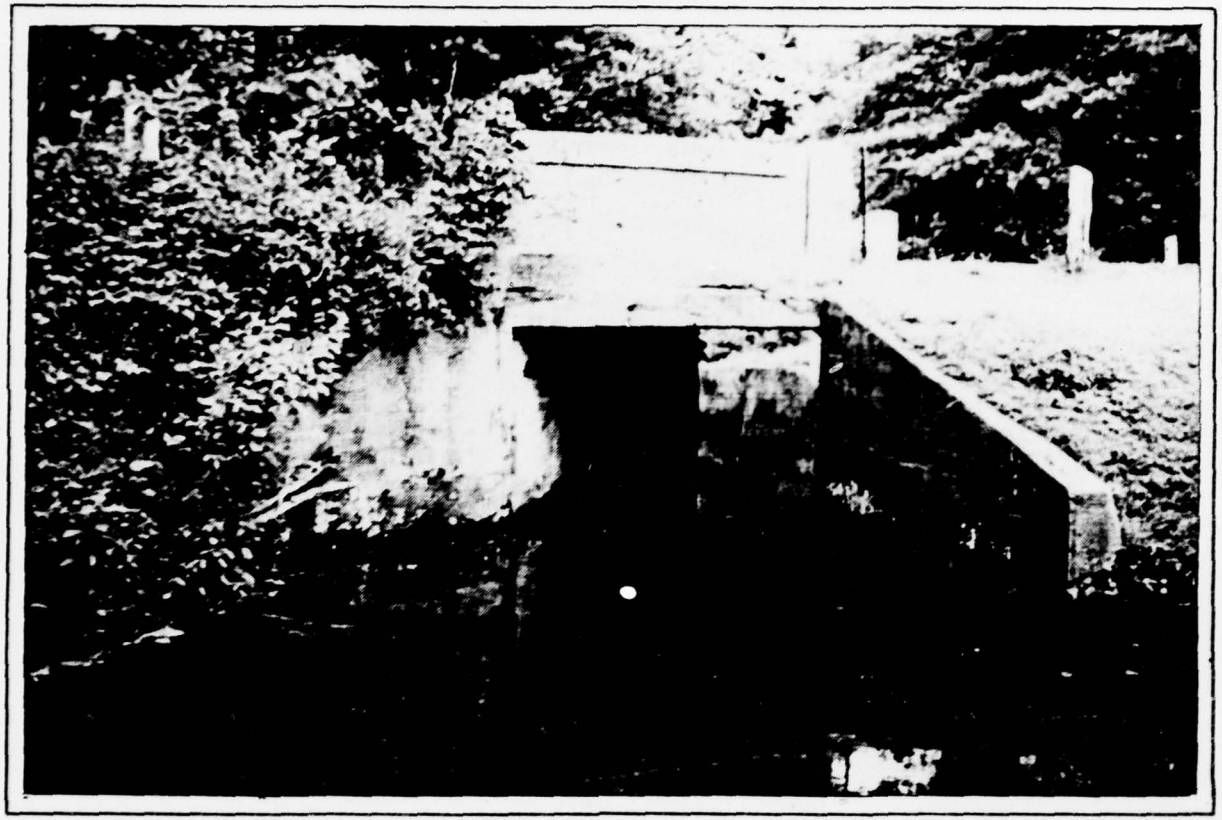
PHOTOGRAPH NO. 10

WET AND MARSHY ZONES JUST BEYOND
DOWNSTREAM TOE.

PHOTOGRAPH NO. 11

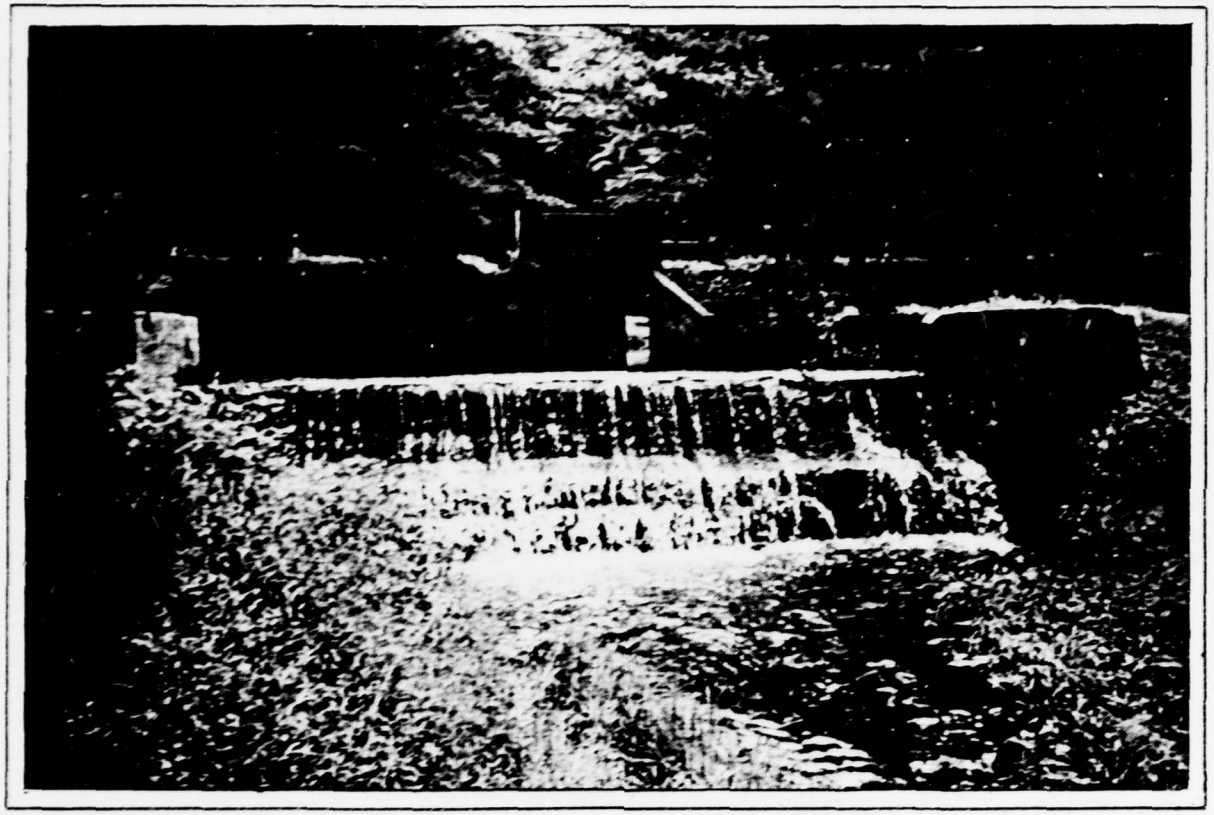
TYPICAL VIEW OF DOWNSTREAM CHANNEL.

PHOTOGRAPH NO. 12



VIEW OF FIRST BRIDGE DOWNSTREAM OF
DAM ON HAY CREEK ROAD JUST BEFORE
THE STREAM ENTERS HAY CREEK.

PHOTOGRAPH NO. 13

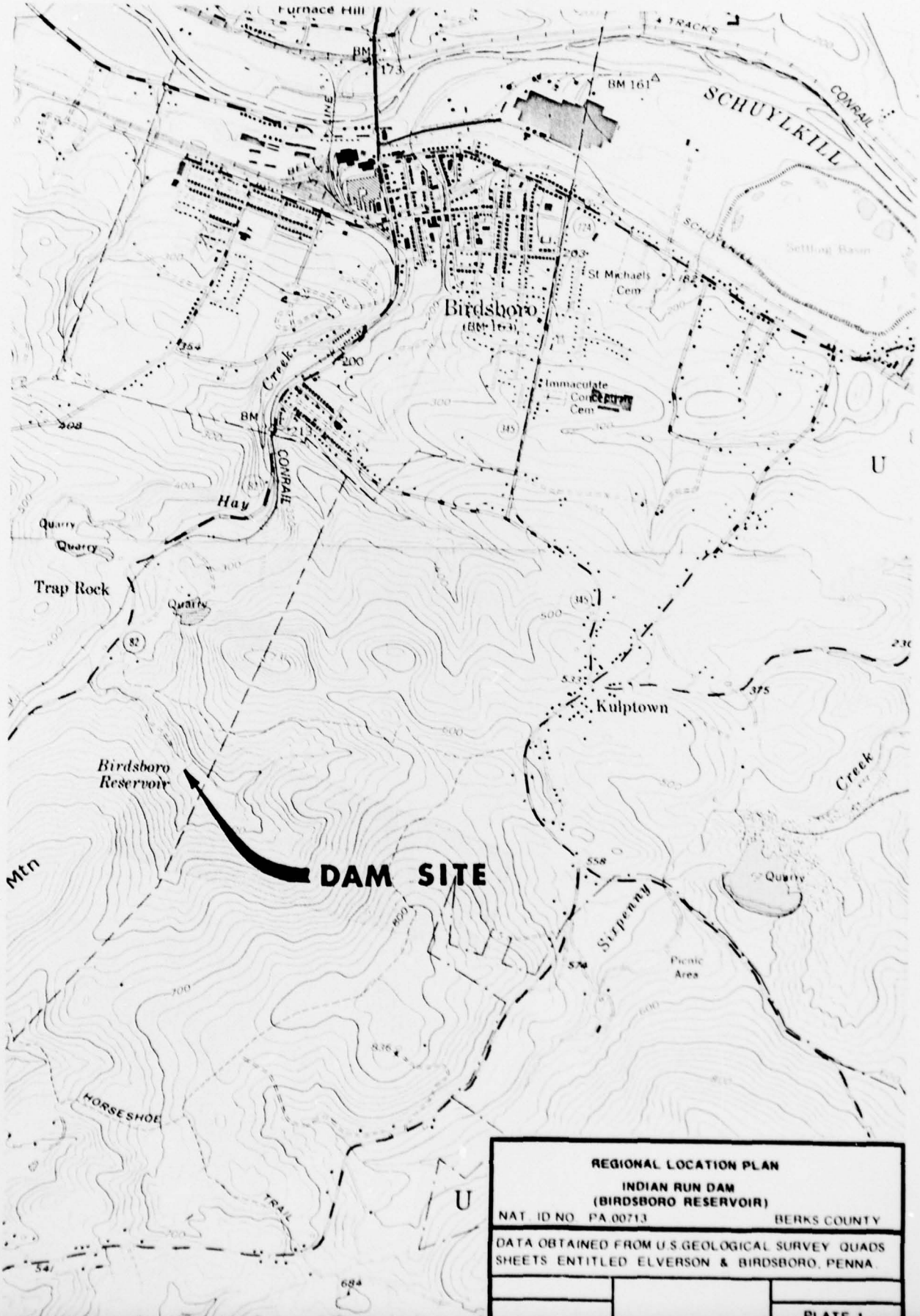


VIEW FROM DOWNSTREAM LOOKING UPSTREAM TOWARDS THE BRIDGE DESCRIBED IN PHOTOGRAPH NUMBER 13.

PHOTOGRAPH NO. 14

APPENDIX

E



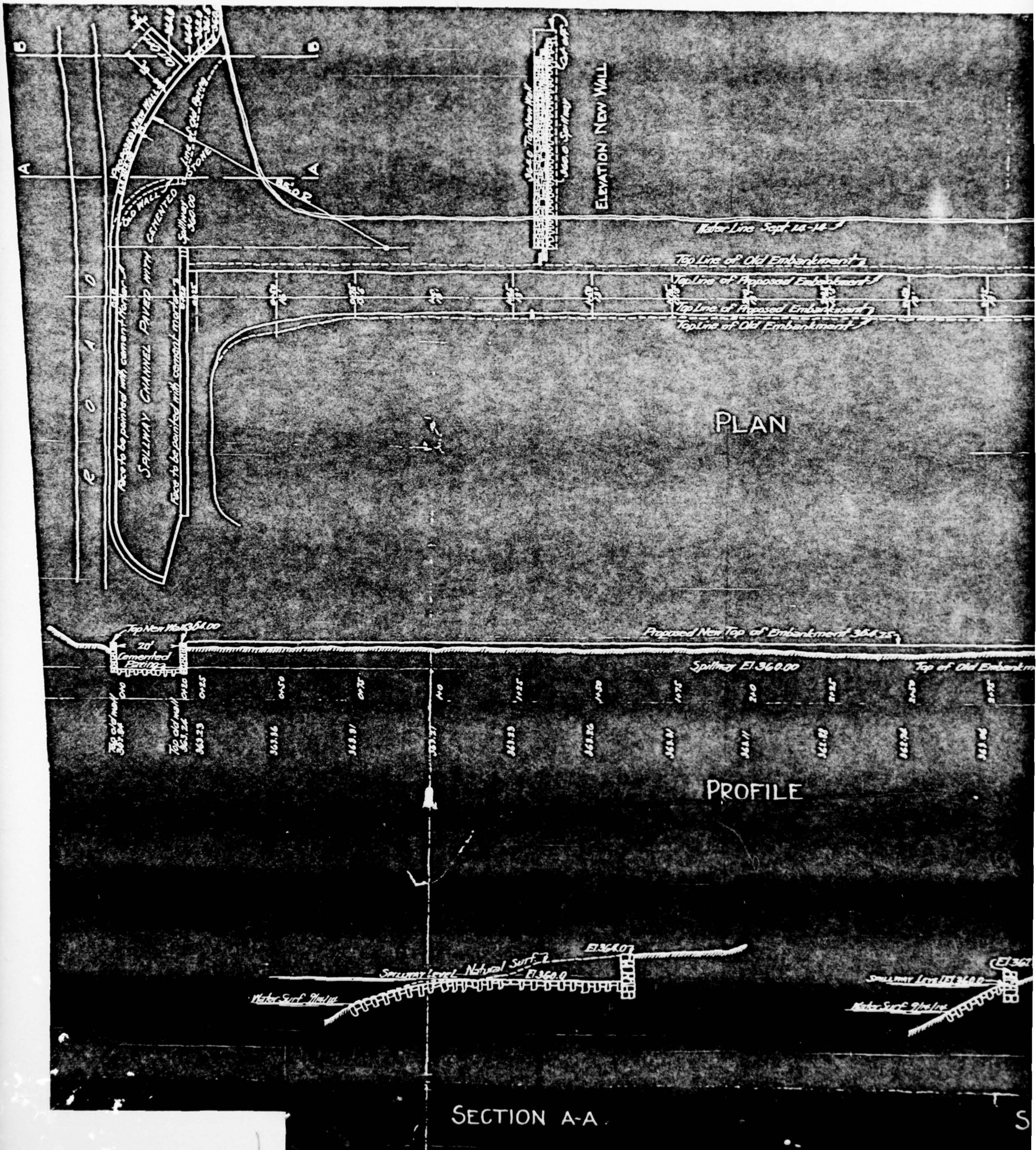
REGIONAL LOCATION PLAN

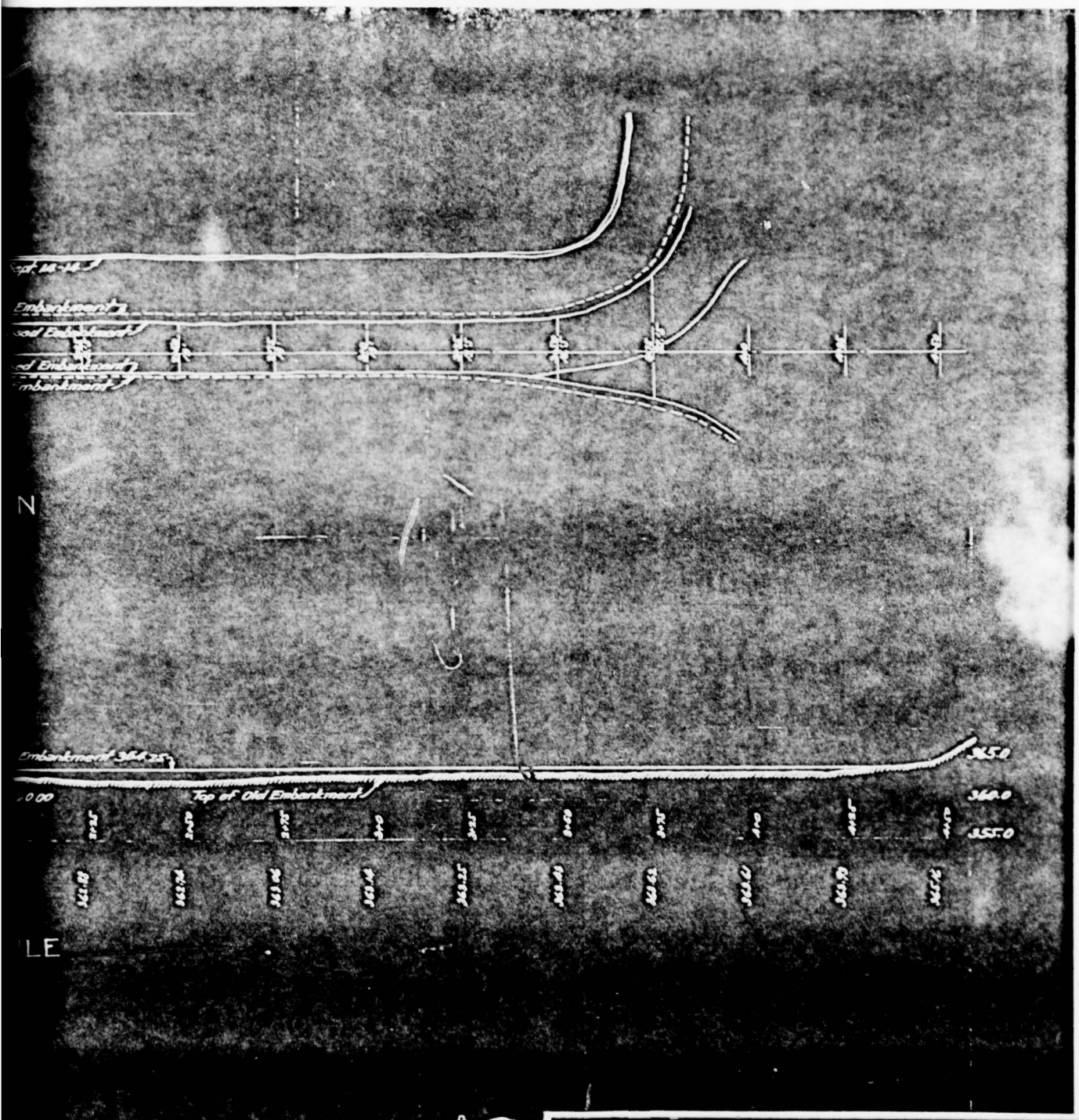
INDIAN RUN DAM
(BIRDSBORO RESERVOIR)

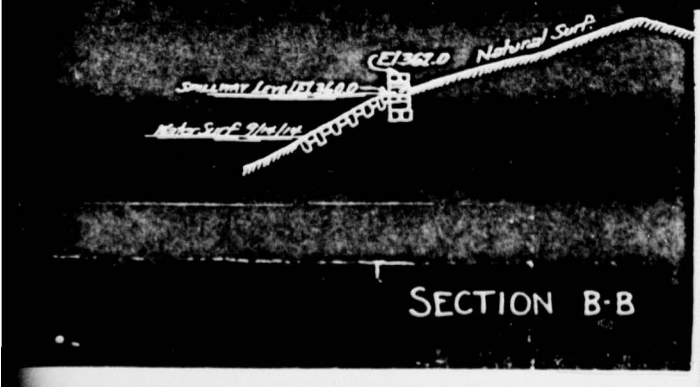
NAT. ID NO. PA 00713 BERKS COUNTY

DATA OBTAINED FROM U.S.GEOLOGICAL SURVEY QUADS SHEETS ENTITLED ELVERSON & BIRDSBORO, PENNA.

PLATE 1


ELEVATION NEW WALL
Water Line Sept 14-14
Top Line of Old Embankment
Top Line of Proposed Embankment
Top Line of Proposed Embankment
Top Line of Old Embankment
OLD WALL
CEMENTED
Spillway 360.00
SPILLWAY CHANNEL PAVED WITH
Face to be pointed with cement mortar
Face to be pointed with cement mortar
ROAD
PLAN
Top New Wall 364.00
20'
Cemented Paving
Proposed New Top of Embankment 364.75
Spillway El. 360.00
Top of Old Embankment
PROFILE
El. 364.0
Spillway Level
Natural Surf.
El. 360.0
Water Surf.
Spillway Level El. 360.0
Water Surf.
SECTION A-A



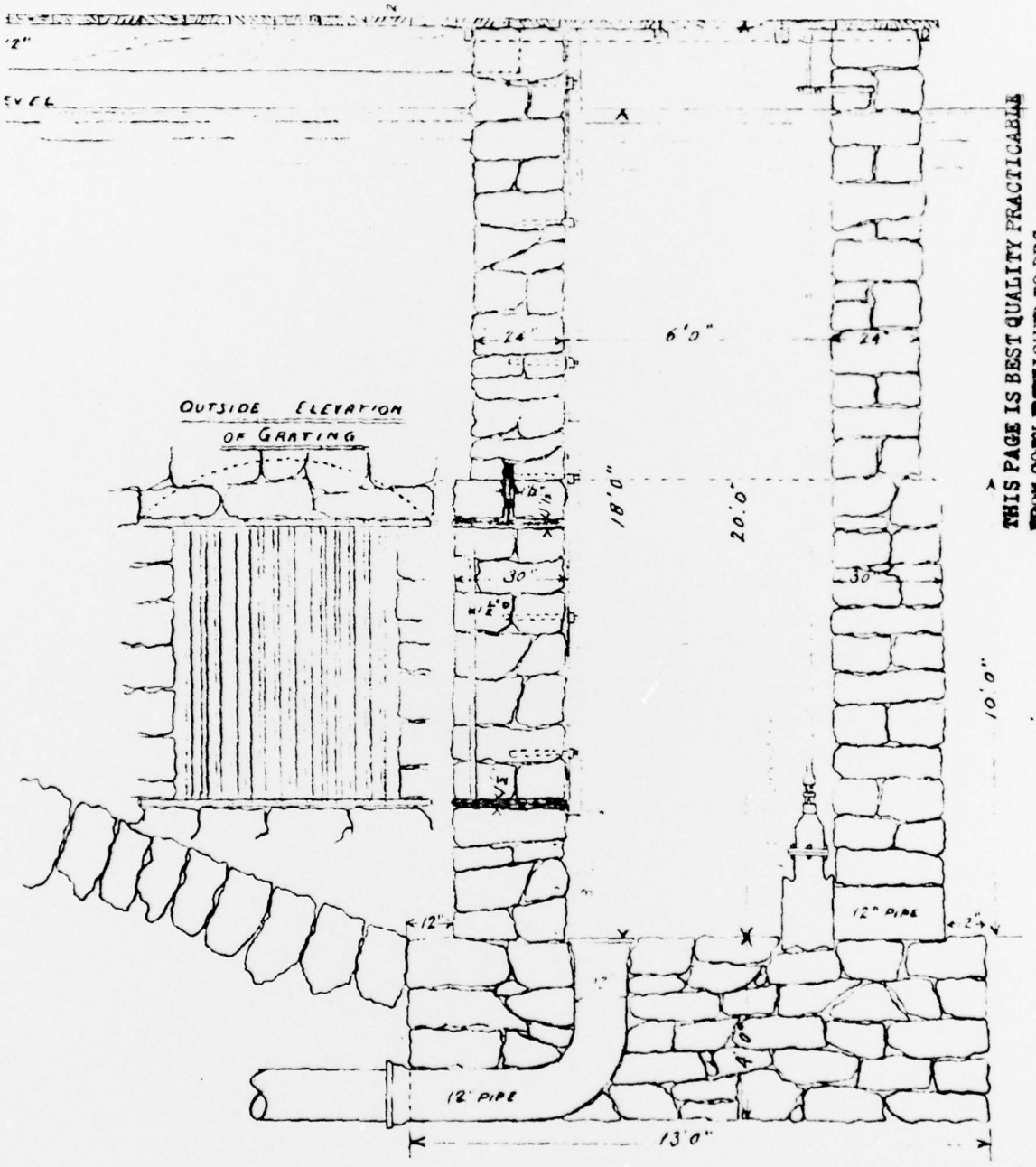


PLAN AND PROFILE OF DAM & APPURTENANT STRUCTURES
INDIAN RUN DAM
(BIRDSBORO RESERVOIR)

NAT. ID NO. PA.00713 BERKS COUNTY

DATA OBTAINED FROM WM. H. DECHANT, & SON CE
PLAN NO. 2860, DATED SEPT., 1914

PLATE 2



PROFILE OF INTAKE STRUCTURE
INDIAN RUN DAM
(BIRDSBORO RESERVOIR)

NAT. ID NO.PA.00713 BERKS COUNTY

DATA OBTAINED FROM DRAWING PREPARED BY
ISSAC S. CASSIN, DATED APRIL,1883

PLATE 3

APPENDIX

F

SITE GEOLOGY
BIRDSBORO RESERVOIR

The Birdsboro Reservoir is located in the Triassic Lowland section of the Piedmont Physiographic Province. The bedrock in the area where the dam is constructed is reported to consist of Triassic diabase (see Plate F-1). The diabase is bounded to the north by Triassic quartzose conglomerate and by the shales, siltstones and sandstones of the Triassic Brunswick Formation, and to the south again by Triassic quartzose conglomerate (Hall, 1967). Bedding is relatively undeformed with a regional strike to the northeast and a gentle dip of 5° to 20° to the northwest (Willard, et al, 1959). No significant faulting has been reported in the area around the dam and no major concentration of joints has been reported. The joints that are present in the Triassic rocks of this area tend to be few in number, widely spaced, oriented parallel to the strike of bedding and dipping nearly vertical (Willard, 1959).

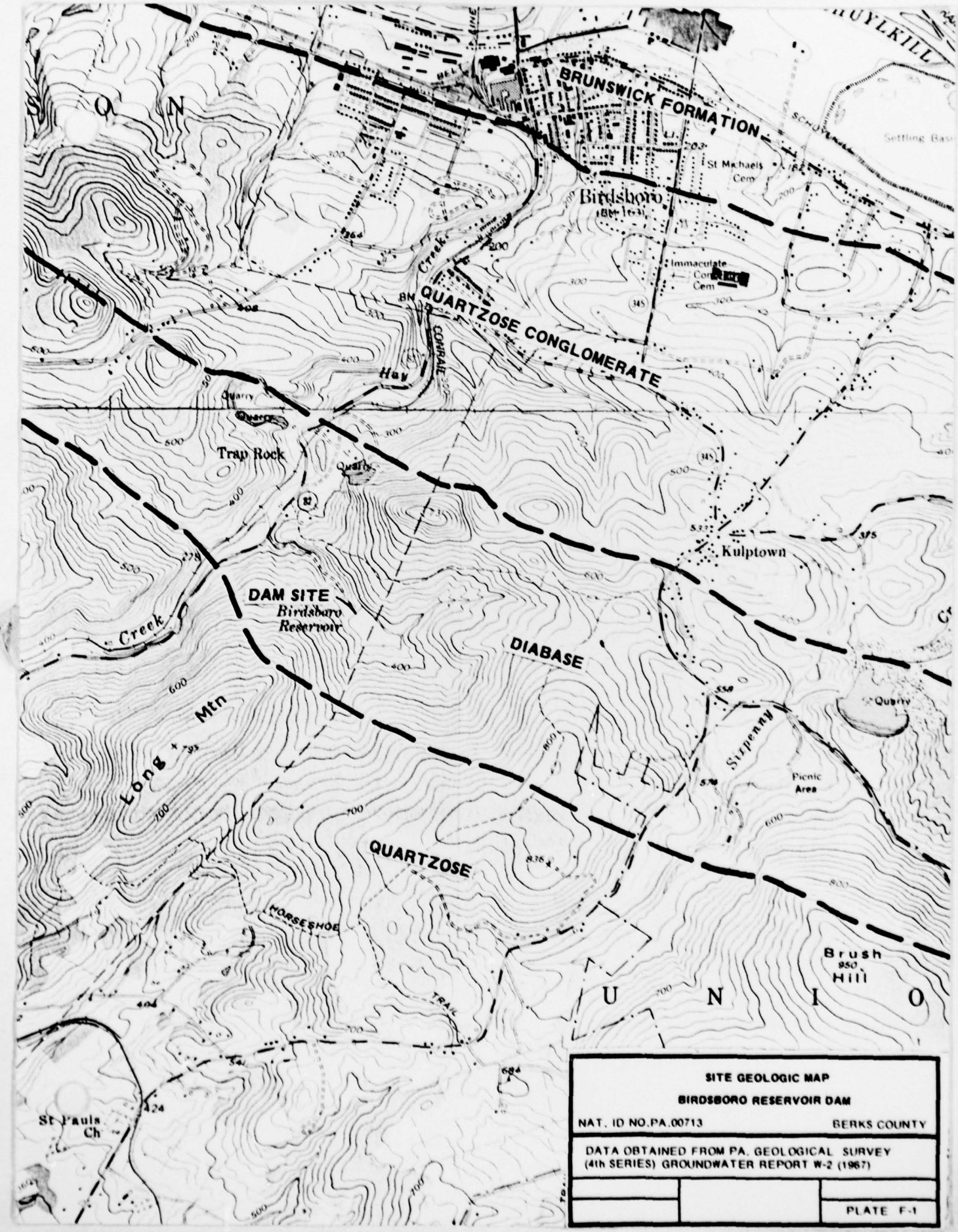
Downstream seepage should be minimal due to the impervious nature of the rock, and due to a lack of prominent jointing and faulting at the dam site.

References:

1. *Glaeser, J.D., 1966, Provenance, Dispersal, and Depositional Environments of Triassic Sediments in the Newark-Gettysburg Basin: Pennsylvania Geologic Survey, 4th Series, Bull. G. 43, 168 p.*

2. *Hall, M.G., 1967, Ground Water in Southeastern Pennsylvania: Pennsylvania Geological Survey 4th Series, Ground Water Report W-2, 255 p.*

3. *Willard, B., Freedman, J., McLaughlin, D.B., Ryan, D.J., Wherry, E.T., Peltier, L.C., and Gault, H.R., 1959, Geological and Mineral Resources of Bucks County, Pennsylvania: Pennsylvania Geological Survey, 4th Series, Bull. C-9, 241 p.*



SITE GEOLOGIC MAP

BIRDSBORO RESERVOIR DAM

NAT. ID NO.PA.00713 BERKS COUNTY

DATA OBTAINED FROM PA. GEOLOGICAL SURVEY (4th SERIES) GROUNDWATER REPORT W-2 (1967)

PLATE F-1